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CONTENTS.

Editorial 353
Programme for the Edison Illuminating Convention..... 356
Abandonment of Municipal Plants in Indiana..... 356
Mayor McClellan on Municipal Ownership..... 356
Electric Lighting in St. Louis..... 356
Electricity in the Purification of Water..... 357
Electric Power on the Farm..... 357
Annual Convention of the Municipal Electricians at New Haven, Conn. 357
Lighting the Pennsylvania Station in New York City..... 359
Production and Use of Mica..... 359
Current News and Notes..... 359
The Power Plants of the United Electric Light Company, Springfield, Mass. 363
Long Span Pole Lines. By A. J. Bowie, Jr..... 367
Carborundum as a Wireless Telegraph Receiver. By H. J. Round.. 370
Predetermination of the Length of Armature Conductors. By A. I. M. Weintraub. 371
Tests of Electrically-Driven Planers. By Geo. H. Schaeffer and Chas. E. Butz..... 372
The Spokane and Inland Railway..... 373
Central Station Performance at San Antonio, Tex..... 373
Recent Electrochemical Developments..... 375
Letter to the Editors:
Lighting Franchise Conditions. By Wellman T. Jones..... 375
Digest of Current Electrical Literature..... 375
Book Reviews. 378
Power Operated Hatches..... 379
Gasoline-Electric Railway Cars..... 380
Pole Line for Erie Traction Work..... 380
Exhibits at the New Haven Convention..... 380
Industrial and Commercial Notes..... 381
General News. 385
Weekly Record of Electrical Patents..... 391

The Tungsten Lamp.

It never rains but it pours, and we can hardly call attention to one new incandescent lamp but another follows close upon its heels. The tungsten lamp, the regular manufacture of which has just been announced by the General Electric Company, and which probably will soon be on the market from other sources as well, has already become fairly well known abroad, although not yet in extensive use. In some respects tungsten is an exceedingly promising material for an incandescent filament. It is an element fairly cheap and certainly obtainable in considerable quantities. It has, according to the experiments of M. Moissan, the highest melting point of any known metal. This fact accounts for the remarkably low specific consumption of the lamps, which is variously stated at 1 to 1.5 watts per candle. The light is naturally pure white and the intrinsic brilliancy very high indeed. On the other hand, tungsten is one of the acid-forming metals, lacking apparently the true metallic texture of common metals and totally incapable of being drawn into wire. The filament used in tungsten lamps is, therefore, not a clean metallic wire as in the tantalum lamp, but an agglomerated filament not unlike that of the osmium lamp, prepared by one or another round-about process from very finely divided tungsten. Physically, indeed, the tungsten filament seems to resemble closely the osmium filament, requiring the use of several long and slender loops to form a lamp of ordinary candle power and voltage, moored very carefully and requiring to be used in a vertical position.

Like the osmium filament, the tungsten one tends to sag and droop under the extreme heat; and what the effect of this will in the long run be it is hard to say. Very long life is claimed for the tungsten lamp abroad, reaching 2,000 hours or so, but we note that the American promoters are somewhat more conservative, claiming merely a life fully as long as an ordinary incandescent. It is said, too, that the tungsten lamp performs equally well with alternating and with direct current, which the tantalum lamp does not. How far this claim will be borne out in practice remains to be seen. In the case of the tantalum lamp, nothing was heard of any trouble with alternating current at first. The same causes which affect its life may also affect that of the tungsten lamp when pushed to high efficiency. In case of the tantalum filament, appearances indicate that failure under alternating current may be due rather to impurities or lack of homogeneity in the wire than to any inherent cause of failure. Tungsten has a lower specific heat than tantalum, and *a priori* would be supposed to suffer at least as much from heating and cooling. This, however, remains for experience to determine, and with the lamp actually in production the facts regarding life will soon come to light. In efficiency the tungsten lamp is distinctly superior to the tantalum lamp and even to the osmium lamp, over which it also has a very great advantage in cost owing to the commoner material of the filament.

As to the effect of the tungsten lamp on the art, many questions remain to be answered by experience. It is imperative that any high efficiency lamp be heavily screened in use. Even

the standard carbon filament suffers considerably when used in a ground glass bulb. The metalized filament seems to be affected even more. Will the tungsten filament stand up to its work any better? If not, then the lamps might be used with separate diffusing globes or for concealed lighting. Can the tungsten filament be successfully used for lamps of large candle power, or will the concentration of heat demand a reduction of efficiency? If lamps of 100 cp, at an efficiency equal to that now claimed can be made, one sees the finish of the ordinary arc at no great distance, and oblivion will also await all other halfway measures. We hardly dare to be too sanguine, however, since the Nernst lamp started with bright hopes and the graphitized filament was going to revolutionize the art. Each has its wide uses and its limitations. If the tungsten lamp can be made to hold up its life and efficiency in series lamps, a vast stride will have been made in street lighting; and again the arc will have to retire. Discounting all the claims made, foreign and domestic, one has the certainty of a practicable lamp at considerably less than 2 watts per candle, of good life and moderate cost. Between the various new lamps now in commercial use, it looks very much as if the days of the carbon filament were numbered. A lamp at 3 watts per candle cannot long hold its own against a 2-watt or 1.5-watt lamp at any cost of electricity attainable commercially. At the latter figure the enclosed arc cuts a sorry figure in competition, and only the flaming arc can show cause for existence. Truly the day of change is already at hand. The inefficiency of light production has been a standing reproach to human ingenuity for a quarter of a century. We have many times predicted a revolution and to-day it seems evidently at hand, blazing up simultaneously from many directions. And the revolution will also most probably involve a radical change in the unit of light, raising this from the present 16 cp to 25 cp or even to 40 cp. Indeed, with 22-cp gas jets and 60-cp Welsbachs, the 16-cp of the electric incandescent has been recognized for some time as inadequate.

New York-Chicago Trolley.

The statement that a man well known as leader in steam railroading was about to launch a New York-Chicago electric railway project has naturally aroused great interest. The fact that Mr. Ramsey will need $150,000,000 for his enterprise appeals to financial curiosity, while his preference for locomotives as against individual motor cars appeals to the electrical engineer. Next, in swift succession, comes another announcement of a rival system, offering the public stock in a kindred scheme at 25 cents on the dollar.

There is, at least, no valid reason to doubt the good faith of Mr. Ramsey, although he may have a little difficulty in getting so much money. It is as certain as the rising of the sun that in a very few years the New York-Chicago trip will be made electrically, without any of the annoyances of steam; even the "roads of anthracite" will have to quit. Both the New York Central and the Pennsylvania systems are thinking, planning and working toward electrical passenger traffic, and some of the best engineering talent of our times has been enlisted to that end by these two great lines. If now competition is to be expected, it will be extremely interesting to note the technical development so far as it may involve points of difference or new invention. There is already abundant choice of methods, but it is one of the elements of the electrical arts to know no resting place or finality, save as a basis of new departure.

The Return of the Lightning Rod.

Evidences are at hand of a judicious revival of the lightning rod which in recent years has fallen into relative neglect. It is true that tall chimneys, spires, and elevated brick structures are nearly always equipped with lightning rods; but the average country house or barn is often left entirely unprotected. Statistics show that the industries of lightning-rod production and installation have fallen off most materially during the last few decades, in spite of increase in population and in house property. One reason for this condition is that the principal danger from lightning when it strikes brick, stone or wooden buildings is fire. Steel buildings are immune. Danger to life, while it is quite appreciable, is not regarded with apprehension by the public. When the owner of a building insures it against fire, by taking out a fire insurance policy, the danger of lightning stroke is at once removed from his mind. The responsibility for troubles from lightning is thereafter shifted to the insurance company. If the company does not insist upon the erection of a lightning rod, why should the owner incur that expense, in addition to the annual premium on the policy? For some reason that is not clear, the insurance companies have not pinned their faith to lightning rods. Possibly they have witnessed so many instances in which lightning damage occurred to buildings equipped with lightning rods that they came to ignore the cases in which lightning rods saved buildings. At all events, the want of faith in the lightning rod as a business proposition by the Fire Insurance Companies is, we believe, the principal reason for the falling off in the use of that article during recent decades.

A recent publication devoted to insurance interests announces that a leading fire insurance company has been collecting statistics covering the past ten years, which show a steady increase in loss by lightning. Over 80 per cent of the estimated loss by fire to farm and country property is attributed to lightning. The country barn is a particularly grievous source of loss by fire due to lightning. It is stated that in view of the experience gained in this way, the fire insurance companies expect to advance rates on farm property not protected against lightning. We hope that this expectation will be carried out; because we believe it will lead to economy in the long run. We also hope that the most modern experience will be availed of in the protection of buildings. There is no need for the massive copper rod conductor. A much greater degree of protection can be secured by the free use of galvanized iron wire, three millimetres in diamater, which is almost invisible and is cheap, than by the more limited use of copper rod fifteen millimetres thick, which is unsightly and dear. Instead of a single copper rod, there should be eight or ten galvanized iron wires let down to ground level from the roof, all tied together at the top, and also at the bottom, by horizontal wires. The top wire would lie on the ridge poles of the roofs. The bottom wire should be connected to good ground in two places at least. All joints between crossing wires should be soldered and painted. The aim of the method should be the birdcage construction, and not the mere insulated rod. Iron should always be used in preference to copper, as the outcome of the experience and the theory of the last twenty years. Finally, after enveloping a barn in a cage of galvanzed iron telegraph wire, judgment upon the results should not be passed upon single cases, but only upon collections of hundreds of cases. There can be little hope of preventing all damage from lightning, and all fire hazard due to lightning. We can only hope to minimize the danger, especially when we deal with so inflammable a material as stored grain.

THE RECTIFICATION OF ALTERNATING CURRENTS.

Although the subject has been endlessly contested, it is generally admitted that arc-lamps work better with direct than with alternating currents; so that, altogether apart from storage batteries, it is desirable to be able to rectify alternating currents for arc-lamp circuits. There are various types of rectifier, mechanical, electrolytic and vacuum-tube. Only the latter, however, is found to any extent in this country. In Europe, the electrolytic rectifier is used to some slight extent. Its efficiency is stated to be about .65, and for low voltages, with not too powerful currents, it is said to be convenient. Care must be taken that the aluminum plates do not rise in service above 50° C.; because above that temperature the action and efficiency fall off seriously. The mercury-arc rectifier is now in fairly wide use in this country, for charging storage batteries, and also for operating direct-current arc circuits. Thirty amperes appears to be the present limit of output, partly owing to difficulties in cooling the electrodes with more powerful currents. The simplicity and the convenience of the mercury-vapor rectifier in service are striking, when we consider how recently the apparatus has been developed. Like single-phase rotary converters, the mercury-arc rectifier gives a larger direct current in amperes than it receives on the alternating side. In fact, the direct current is not far from double the root of mean square or indicated alternating current. The direct voltage of delivery is, however, limited to about half the alternating terminal voltage, when charging storage cells from 220-volt circuits, the efficiency being in the neighborhood of .80 and the power factor about .90.

It makes a beautiful experiment to watch the alternate flashes in a mercury-arc converter at work, with the aid of a stroboscopic disk. A disk with a hole in it is interposed between the converter and the observer, and is driven by a motor. The speed of the motor must be controlled so that the disk is almost in synchronism with the alternations of current supplied to the mercury arc. At exact synchronism the flashes at one anode will be seen apparently sustained, like an arc lamp. At a speed slighly below synchronism, the flash is seen slowly to leave one anode, run down that side, contract into the cathode, run up the other side and catch on to the other anode, the seizure of the latter being completed before the release of the former is over. The handing over of the arc from one anode to the other, which may actually occupy one two-hundredth part of a second, is thus drawn out stroboscopically to many seconds.

It is not generally known that mercury arc rectifiers can be made to work backwards, or that it is possible; although perhaps not yet practicable, to convert a direct current into alternating current. For this purpose a plurality of anodes are introduced into the vacuum tube, clustered around a central cathode. Direct current is supplied from the ring of anodes to the cathode, by connecting the anodes in parallel. As soon as the arc is started to the cathode at any one anode, it does not persist there, but tends to revolve, or move on to the next anode in the ring. In this way, the arc will continue indefinitely gyrating around the cathode center, making a certain number of revolutions per second, depending upon the distance between adjoining anodes, the current strength and other conditions. The primary coils of transformers are included in the branch wire to each anode; so that one impulse of alternating current is generated in each secondary coil per revolution of the arc. By arranging six such anodes in the ring and connecting the primary coils in six-phase transformer arrangement, three-phase alternating currents may be derived from the secondary windings; or, by means of four anodes, two-phase currents have been derived.

A STUDY OF ELECTROLYSIS.

A recent report of a commission of the German gas and water companies on earth currents contains some instructive data. Apparently the conditions in Germany with respect to electrolysis are not unlike those found in this country. Of the nine cities which have been investigated in the last two years, all showed conditions which favor electrolytic action, but the actual damage varied greatly from place to place. In Erfurt, for instance, a town of 90,000 inhabitants, containing one of the oldest German tramways, the damage has been decidedly serious and even recent work in the installation of return conductors has been unfruitful. There had been great general injury done, and when some months ago the water service was changed to a new reservoir giving 60 lbs. per square inch additional pressure, ten breaks in the pipe quickly appeared at all of which were plain signs of electrolytic corrosion. On the other hand, Freiburg, in which the installation was so made as to give exceptionally small drop in the rail return, showed practically no electrolytic damage at all. In Hamburg, after insulated return conductors were installed corrosion of the pipes ceased. Stuttgart presented one of the most singular conditions found. Uninsulated return conductors were laid in the same trench with the neutral conductor of the lighting system and the two were bonded together, thus making the water pipes negative to the rails over most of the working area. The drop in the rails is small, but there is an extraordinary drop along the pipes averaging 14 volts per kilometer and the electrolysis is serious. The earth in this case is damp and undoubtedly aggravates the trouble. In Leipzig, two tramway companies operate, one using insulated return wires with carefully bonded rails; the other having bare returns and poor bonding. In the former system, the mean voltage from pipes to rails was 1.1 volts; in the latter, 5.5 volts, which is sufficient evidence of the difference between good and bad practice. In Hamburg, the maximum voltage found from pipe to rail was 0.8 and the average 0.4 volt, a condition which would be hard to duplicate in any American city.

Electrolysis is one of the evils for which there is no panacea. The treatment, to be sure, follows well defined lines, but is essentially symptomatic, and one of the chief difficulties is that the progress of the malady is so gradual that a proper diagnosis is often delayed until conditions have become very grave. It would be well if there were made in this country a really systematic investigation of conditions existing on the pipe systems, after the fashion of this German work. Few American cities are willing to expend money for technical work that can possibly be shifted forward into the budget of a succeeding municipal administration. Yet the foresight of this sort is the one thing most important in preventing damage. Fortunately, electrolysis is often checked by the nature of the soil, as appears, by the way, in Danzig, so that bad underground currents do not necessarily imply rapid destruction of pipes. Yet, there may be many cases in which a relatively slow corrosion is going on year by year finally to appear as a general tendency to breaking down. More commonly there are premontory perforations at particular points. The only safe procedure for a city is to examine the situation at periods frequent enough to disclose its true condition and to compel the application of the proper remedies. These are generally in the line of good installation so that there is little real hardship to the trolley companies.

Programme for the Edison Illuminating Convention.

As already announced the convention this year of the Association of Edison Illuminating Companies will be held at the Hotel Frontenac, Thousand Islands, St. Lawrence River, September 4, 5 and 6. Subjoined is an outline of the excellent programme of the papers: "Costs of and Results from Advertising and Soliciting," H. K. Mohr, Philadelphia, Pa.; Details and Costs of an Inexpensive Underground System for Alternating Distribution in the Semi-Suburban Residence District of a Large City" (a symposium of short papers by the underground experts of the large companies), W. T. Morrison, New York; Wm. C. L. Eglin, Philadelphia; D. W. Ropes, Chicago; Sidney Hosmer, Boston. "Adjuncts to the Power Load," C. J. Russell, Philadelphia; "Investigation of Various Losses in the Electrical System of the Edison Electric Illuminating Company of Boston," L. L. Elden, Boston; "Recent Developments in Incandescent Lamp Manufacturing," F. W. Willcox, Harrison, N. J.; "Various Types of Lamps and Practical Hints on Illumination," Steven B. Burrows, Brooklyn; "The Isolated Plant Question," M. F. McAlpin, New York; "Alternating Current Motors for Various Purposes, with Especial Application to Elevators," E. W. Lloyd, Chicago; "Evening Talk with Stereopticon Illustrations," W. S. Andrews, Schenectady; "Legislative Influence on Income Through the Meter," Caryl D. Haskins, Schenectady; "A Brief Report on Municipal Ownership," Arthur Williams, New York.

Abandonment of Municipal Plants in Indiana.

Several cities in Indiana have found out recently that their municipal lighting plants are a bunden, and are giving them up. The electric light plant at Muncie is passing into the hands of a private company. The city of Marion is considering a proposition for lighting the streets at a lower figure than it is now paying through municipal ownership. The mayor of Richmond, thrice elected on a municipal ownership issue, recommends that the electric light plant be sold and that the city go out of the business, and the people of Logansport have appointed a committee to inquire into the feasibility of abandoning the lighting plant on account of the excessive cost to the city. The reason given in each of these cities is that the cost of lights is greatly in excess of what it should be and very much more than if the cities were being served by private corporations. In Marion, for instance, the average cost per arc lamp has been over $50 a year, while a private company proposes to take over the city plant and furnish street lamps at a cost of $47.50 per year. There are now 205 lamps on the streets, and the company proposes to furnish these and any additional lamps that may be ordered by the Council at this figure.

The city of Marion put in its electric light plant and issued $24,000 in bonds to raise the money. These bonds have recently been refunded, but not a dollar of the principal has ever been paid. The municipal plant was established thirteen years ago, and the people of that city are still paying interest on $20,000 of bonds issued to cover the cost, and will continue to do so after the plant passes to the company, with which a ten-year contract has just been made.

Neither Richmond nor Logansport has paid its bonds issued for the establishment of the plants, and, if they are not disposed of, money will have to be raised to keep the plants in repair. It is charged that, while electric lighting by private capital has become cheaper in the past few years the municipal plants are becoming less efficient and the cost of electricity is higher.

The contract by which the City of Muncie secures service from a private corporation and virtually abandons its plant is regarded by the city authorities and by many citizens as an exceptionally good one. The contract is to run for ten years and the city is to pay $47.50 for each arc lamp burned 4,000 hours in each year. The contract contains a clause declaring that "the lines of poles and wires now in use and owned by the city shall be turned over to the company, rent free, to be used during the entire term by the company." In other words, the city allows the company the free use of all its equipment outside of the machinery, which is old and in poor repair, and the company enters upon the discharge of its contract without having to go to any expense for this part of the equipment. The poles and wires accommodate 260 street arc lamps, and are estimated to be worth not less than $15,000. The company agrees to return them to the city at the expiration of the ten years in as good condition as they are in to-day.

The reason the city is anxious to go out of the business is that the cost per light was constantly increasing, and the time was rapidly approaching when extensive repairs would have to be made on the plant. The experience of the past five years shows that the new contract price will represent a great saving to the people, even though the bonded debt of $20,000 is practically unproductive. The City Council was glad to close a deal which took off its hands a plant that was a constantly growing expense. It is argued that the city can well afford to sacrifice the old machinery and still make money by going out of the business. In 1901 the cost at the plant was $71 per lamp; in 1902 it was $73; in 1903, $84; in 1904, $65, and in 1905 it was $61, the figures for the two years last mentioned representing practically no outlay for new equipment. The margin between $47.50 and the average for five years under municipal ownership was so great that the deal with the private corporation was quickly consummated.

Mayor McClellan on Municipal Ownership.

Mayor McClellan, of Greater New York, has been traveling in Europe this summer. In a recent interview, while visiting Berlin, Germany, he said: "Much of Europe's vaunted municipal superiority is a delusion and a snare. I have kept my eyes wide open for evidence of successful municipal operation, particularly in Germany, which is constantly held as an example, but I have failed to find it.

"I have discovered conditions in cities like Frankfort and Dresden, which own their street railways, which no American community of second rate importance, to say nothing of New York or Chicago, would tolerate. Not only is the traffic of these places insignificant, judged by American standards, but it is handled inadequately and inefficiently.

"The conditions of Great Britain, with the possible exception of Glasgow, where our cousin, Mayor Dunne, of Chicago, has been taking lessons, are even worse than on the Continent. The British tramways act of 1873 gives municipalities options upon franchises before the franchises exist, and the result has been perpetuation of old fogyism and the stunting of private enterprises. My European observations convince me more than ever that municipal operation is the last desperate means which ought to be resorted to only when private enterprise has absolutely failed.

"Berlin's oft-quoted ideal municipal conditions are lacking even in so elementary a thing as the regulation of traffic. Here and there a few helmeted gentlemen mounted on martial steeds look daggers at the frightened truck drivers and pedestrians, but the traffic around them is in a state of chaos. One good idea in Berlin is that of repairing the streets in the night time, thus reducing the interference with traffic to the minimum."

Electric Lighting in St. Louis.

Harbor and Wharf Commissioner Whyte at the meeting of the Board of Public Improvement of St. Louis, held August 14, suggested an ordinance for the letting of a twenty-year contract to light the streets, parks and public places in St. Louis. If the bids received do not reach the proper figure, Mr. Whyte suggests that a municipal lighting plant be installed. The present lighting contracts will expire on August 31, 1910. When the last contract was let in 1900, the city was kept in darkness for several weeks by the failure of the Municipal Assembly to make any provision for lighting during the letting period. Mr. Whyte claims that the prices, which now average $98 a year for

arc lamps and $28 for incandescent and gas should not be more than $60 or $65 a year for arc lamps and $22 for gas. These prices are based on the alleged operating expenses of the municipal lighting plant at Detroit, Mich. The city could save by these lower prices, enough money to light brilliantly the business district of the city. Mr. Whyte's figures are based on the use of 2,000 lamps, which will result in a saving of $150,000 a year.

The city lighting expenses under the present contracts, on an average, are as follows: Electric arc lamps, $110,000; incandescent and gas, $395,000; lighting of Carondelet, separate contract, $43,000; municipal buildings, $20,000.

Mr. Thomas Carter, supervisor of city lighting, has been working on plans for a municipal lighting plant for some time. It is estimated that the cost of erecting a municipal lighting plant with its necessary conduits in the so-called underground district, would be $800,000. The operating expenses for such a plant is estimated at $400,000 a year. Even at the maximum price of $70 for each lamp 700 new lamps could be installed each year. In Detroit the alleged cost of operating each lamp for a year under the municipal system is $61; but the actual figure is nearer $100.

Mr. Whyte suggests that no contract be let unless a price as low as $61 a lamp or near that figure, be secured. In case no such bids are made and the lighting companies should attempt to keep the prices up, Mr. Whyte suggests that a municipal lighting plant be built.

Electricity in the Purification of Water.

In a letter to the director of the Department of Public Works, Philadelphia, Pa., Mr. W. W. Gibbs, president of the United Water Improvement Company, gives some interesting figures on the results obtained in the use of electricity, for removing bacteria from large quantities of water. Tests have been made at a plant having a capacity of one million gallons of water per day. Bacteriological examination showed that the raw water of the Schuylkill River at a certain point contains as high as 2,500,000 bacteria per cubic centimeter; after a rough straining, to remove the coarser particles of suspended matter, the water contains from 253,000 to 700,000 bacteria; after ozonization it contains from 5 to 55.

The process of ozonization is electrical, current at 100 cycles and 10,000 volts being employed. By the use of inductance coils and condensers, numerous discharge points assist in the formation of pencils of blue light. Atmospheric air, which is drawn across these points by means of an air-pump, is thus converted partially into ozone. The ozonized air is then forced through a standpipe in which it meets a current of water flowing in the opposite direction. The contained bacteria are destroyed by the ozone. It is stated that about 200 kw-hours of electrical energy are required for each million gallons of water treated.

Electric Power on the Farm.

An interesting description was given in these pages last week as to the use of electric power on the farm, in that case the farmer having installed his own hydro-electric plant. We now note that work of a similar nature is being done on farms along the route of the Aurora-Elgin & Chicago Electric Railway. In this instance, the railway simply furnishes the power. The installation was done by local electrical contractors. Within five or six miles of Elgin there are about fifteen installations, and others are scattered along the line. The district around Elgin is noted for its dairy products, and the motors are in most cases employed to drive feed-crushing and grinding machinery. In almost every instance the motor is installed in a detached building, and a chute is provided for protection to the belt, which drives the line shaft in the building in which the machinery is installed. In installing the motors every precaution has been taken to protect them from the weather, and to prevent possible damage to the wiring. The houses covering them are built tight, to avoid the possible entrance of water, and are lined inside with sheet asbestos. A meter is installed in the house with each motor, which is usually of 15 hp capacity. The total cost of installation of a motor is about $600. This includes the cost of erection of the building, the cost of the motor, the expenses of running the line from the tracks of the railway, and the work of installing the wiring and connecting up. The rate charged by the railway company is usually 4 cents per kw-hour. In one instance, the cost of the energy used in grinding corn for fifty cows, and sawing wood, etc., was $2 per month. The cost was about one-half cent per bushel for grinding corn.

The farmers are all highly pleased with the performance of the motors, as practically no trouble has been experienced with any of them. All the care that the motors have required has been that of oiling them at frequent intervals and renewing the brushes once or twice a year. Power for the motors is taken direct from the trolley and carried on pole lines to the motor house. The advantage to a railway company, having surplus power, of supplying such service can readily be seen, as local firms can be induced to make the installations, and then all the company is required to do is to read the meter and collect the bills.

Annual Convention of the Municipal Electricians at New Haven Conn.

The eleventh annual convention of the International Association of Municipal Electricians was called to order by the president, Mr. Jerry Murphy, of Cleveland, O., on Aug. 15, at the aldermanic chamber, City Hall, New Haven, Conn. After the usual invocation by the Rev. Mr. Knight, and addresses of welcome by the Governor of the Commonwealth, Henry Roberts, and the Mayor, John P. Studley, and responses by Past President Hatch and Mr. Yeakle, on behalf of the association, a gavel was presented by Ex-Mayor Hendricks. The president, Mr. Murphy, then made his address, touching upon the duties of a city electrician. He also read a paper on "The Advisability of Placing the City Electrician Under Civil Service Rules." In this paper Mr. Murphy expressed himself as being in favor of the merit system. It was his opinion that the examination it was necessary to pass tended to cause a better class of men to seek city offices. This paper was discussed by Messrs. Hatch, Ellett, Yeakle, O'Hearn, Barnes, George and Petty. The opinion was unanimous that civil service rules, if properly made and enforced, would work to the advantage of all public officers. Some criticism was made, however, that too often the rules were not properly lived up to, and as a consequence, they had proved a hindrance to progress in municipal matters.

A committee was appointed composed of Messrs. Hatch, George and Petty to report on civil service rules at the next convention.

After the appointing of a nominating committee and the reading of some letters and telegrams the morning session adjourned. The afternoon session was opened at 2.30 p. m., and was devoted to the electric light department of the association. Mr. A. S. Hatch, the chairman of this department, made an interesting report of progress.

The report contained a notice of the progress made in the application of alternating currents to electric traction and in the electrification of steam railroads. Mention was also made of the progress in the electrochemical industries. Much space was devoted to municipal electric lighting in the United States, and to the new electrical liluminants, including flaming arc lamps, metallic and graphitized filament lamps, mercury vapor and magnetite lamps.

This report was discussed by Messrs. Bradshaw, George, O'Hearn and others, and the questions in the Question Box relative to the electric light and power department were taken up. These questions were:

Street Lighting: How are "outs" reported and what record is kept of them? What notices are given the company?

Do you prefer mast arms or center suspension in order to

put the lamp in the center of the street? With the former the lamp is not quite in the center and with the latter there are two poles instead of one in the street.

What restrictions are made in the disposal of broken globes and carbon stubs? How badly broken may a globe be before it must be changed?

What constitutes dark and moonlight nights? If the night is cloudy though moonlight, can you compel the lights to be turned on?

What methods are adopted to know the company is furnishing full current to the circuits?

Answering the reporting of "outs," Mr. O'Hearn said that in Cambridge the practice was to have the police report to the public supply company who kept an inspector on duty at night, and upon receipt of the notice from the police of a lamp out, this inspector was at once sent to trim it. Others reported similar systems, based upon the reports of the police.

Regarding arc suspensions it was said that for ordinary or business streets where there was no foliage, the suspension by mast arm would suffice, but in heavily wooded streets such as are met with in most of our suburban cities it was better to use the center suspension, although it necessitated the use of two poles.

Mr. Hatch, speaking on the subject of the disposal of broken globes: "The tendency of a trimmer is to throw the broken globes and stubs in the nearest vacant lot; some cities, however, have introduced ordinances compelling the companies to provide proper receptacles." Some of the trimmers are reported as using the carbon stubs to mix in with their coal, and so save on their winter's coal bill.

In reply to the question of what constitutes dark and moonlight nights several members favored the Philadelphia schedule as being the best. Wherever the moonlight schedule was in force a proviso should be introduced that the lights can be lit on an hour's notice on especially dark or cloudy nights.

The evening session was opened by Mr. O'Hearn, who made his report as chairman of the Inspection Department. Mr. O'Hearn spoke of the meeting with the Committee on National Code, and the changes which had been made in the Code. Regarding the interpretation of the rules it was his opinion that it should be as nearly the same in all localities as possible. He believed the Code should not be deviated from, but, if necessary, additional rules should be adopted in certain localities.

A paper by Mr. C. R. George, on "Conditions Surrounding the Inspection of Wires in the Southwest," was read by the author.

This paper gave an account of the influence exerted by politicians in the selection of municipal inspectors, and the favors the politicians expect to receive from the inspectors. It is suggested that municipal inspectors make it a practice to combine their efforts with those of the Underwriter inspectors. There should be frequent interviews among inspectors, with the National Electrical Code as the subject, in order to insure a uniform interpretation of the Code.

This was discussed by Mr. Smith, of Norfolk, Va., who spoke of the local rules in force in his city, especially those relating to interference of house wires by carpenters, plumbers and other craftsmen. These were subjected to a fine if they damaged any installation of wires. Mr. Bradshaw, of Charlotte, N. C., also discussed the paper. He believed it would be a good idea to have an exchange of ordinances of the various cities. Messrs. Brophy, Yeakle, Barnes and Petty also discussed the paper.

Mr. Hatch gave estimates of the costs of installing and operating a trackless trolley line between Detroit and Bell Isle. It is proposed to erect a power house for supplying electricity to eight cars, the machinery consisting of a 100-kw motor-generator with proper controlling equipment. The building and apparatus would cost $16,000; eight cars with trolley carriers, $24,000; six loading and six unloading stations, $4,800; 7,000 ft. of double trolley construction on a bridge and 8,850 ft. of double trolley construction on land would cost $7,125, making the total cost $51,925. The system requires two trolley wires, a positive and a negative, which permits the use of a riding trolley carriage, or telpher, consequently the trolley wires would be placed as far to one side as the trees will allow. It is estimated that the operating cost, maintenance and interest, would be 48 cents per round trip per car, or 24 cents each way. At a two-cent rate per passenger, the cost would require an average of 12 passengers per trip. Each car can carry 40 passengers, so that sufficient margin has been allowed for profit. The cars are to be of the automobile type, with light canopies for summer use, and with closed sides and electric heaters for winter use. All loading and unloading is to be done on one side only; there will be no steps, and the openings to the aisles will be closed by gates under the control of the motorman.

In the Question Box the following questions relating to inspection were read:

Inspection: What restrictions are placed on running services, particularly telephone and electric light services from distributing poles in the center of the block with both classes of wires radiating in all directions, interlacing through each other?

What restrictions are placed on leakage of current from railway tracks to water pipes, and what records are kept of such leaks?

What are the restrictions made concerning wires strung on buildings?

Who trims the trees, and what are the rules governing it?

Do any cities have an ordinance permitting or compelling pole lines being put on lot lines instead of streets and alleys where there are no alleys, or where they run in the wrong direction?

Answering question (1) Mr. Hatch said the proper way was to place them on the side of buildings rather than in a fan shape, slip shod manner so often done.

Capt. Brophy, in response to the request for an answer to question (2) said: "Boston requires rails to be bonded and in addition requires return feeders. The railroad companies make semi-annual tests of rail bonds and of insulation of span wires. Frequent measurements are made to determine the difference of potential between the rails and cables and pipes." It is a difficult problem to properly bond rails. Return feeders are necessary in all large systems. The danger zone has been much reduced by the connecting of the negative bushing to the rail.

Others discussing the subject said it is the duty of the inspector of wires to see that all rail bonds are in good order, and a difference of potential of more than five volts should never be permitted.

Question (4) was answered by Mr. Thompson, of Richmond, saying: "My city trims trees in the proper manner by a city nurseryman. There is little, if any, fault found with the manner in which this is done, as he is a competent man."

Question (5) brought forth the fact that few cities have ordinances on the subject.

The morning session of Aug. 16 was devoted to "Underground Construction." Mr. Gascoigne made a report of the progress during the year. A paper by W. H. Thompson, of Richmond, was then read, entitled "Comparison of Underground and Overhead Wiring, and the Relative Values of Single Rubber Covered Wire and Lead Encased Cable for Underground Construction." In this paper the author favored underground construction as against overhead, and also advocated lead-encased cable.

Discussing this, Capt. Brophy gave an interesting history of the underground systems of this country. He said the first to try this system was Mr. Barrett, in Chicago, who used office wire in wooden duct. Boston was the first city to use lead-covered cables.

The Aerial Construction Department report was made by Mr. Will Y. Ellet, of Elmira, N. Y. He said the tendency all over was for better construction and stronger. This was discussed by Messrs. Gascoigne, Petty, Bradshaw and others.

Mr. Yeakle, of Baltimore, Md., opened the evening session by reading a paper on "Details of Certain Auxiliaries to Fire Alarm Apparatus." He also made a report on the Fire Telegraph Department of the association.

Mr. Yeakle outlined certain auxiliaries to fire alarm apparatus, including a gong in the engine house which not only sounds the call for action, but, by means of simple attachments, releases the horses, and at night closes the switch which controls the lamps. The power for operating the device is obtained from the electric lighting circuits.

In the discussion which ensued the answers to two questions relative to lighting police and fire alarm boxes were included as being in the same division. Mr. Yeakle said he connected his boxes to the nearest fire house and used an 8-cp lamp enclosed in a red shade placed above the box as a means of illuminating it. The scheme worked very well, and he was extending it in Baltimore. Mr. Gascoigne, of Detroit, suggested Nernst lamps as the source of light for the boxes. Others spoke of the use of gas lamps with red globes above the boxes.

The remaining questions in the Question Box were then discussed. They were:

Is it not feasible to have a combined sewer and subway system, owned by the municipality, the subways to be rented to the public service corporations?

What are the best periodicals to take?

What are the best books to own?

Answering the first question, Mr. Bradshaw did not think it feasible. Several others agreed with him. In answer to the second question, Mr. Hatch mentioned several technical journals, and he also spoke of the best books to own, his opinion being that it was necessary to secure specialized books, as those wherein an author attempted to be all embracing could not be relied upon.

The morning session of Friday, the 17th, was devoted to business. Norfolk, Va., was selected as the next meeting place. The date will be decided later by the executive committee.

The following officers were elected for the ensuing year: President, T. C. O'Hearn, Cambridge, Mass.; first vice-president, James Grant, New Haven, Conn.; second vice-president, C. R. George, Houston, Conn.; third vice-president, J. Berry, Indianapolis, Ind.; fourth vice-president, W. H. Bradt, Troy, N. Y. Executive committee, A. B. Smith, Norfolk, Va.; J. B. Yeakle, Baltimore, Md.; Wm. Crane, Erie, Pa.; Jerry Murphy, Cleveland, O.; W. M. Petty, Rutherford, N. J.; A. S. Hatch, Detroit, Mich.; W. H. Thompson, Richmond, Va.; C. F. MacDonald, Ottawa, Can. Secretary, Frank P. Foster, Corning, N. Y. Treasurer, C. H. Diehl, Harrisburg, Pa. Finance Committee, L. W. Kittridge, New Haven, Conn.; C. E. Bradshaw, Charlotte, N. C.; W. D. Clayborne, Savanah, Ga.

Lighting the Pennsylvania Station in New York City.

The New York Terminal with its tunnels, for the New York, Pennsylvania and Long Island Railroad is of such magnitude that it could easily accommodate a traveling population equivalent to that of a large city, and it is obvious that the equipment for the various services required, independent of the transportation question, should present many interesting problems, not the least being the choice of an enonomical lighting service. The unusual proportions of the rooms to be lighted, the long hours of burning, and the continuity of the service, made it necessary to investigate all systems thoroughly and impartially. After a careful and exhaustive study the engineers have decided to use the Nernst lamp.

It is doubtful if there is another room in the country that has the proportions of the main waiting-room, which is approximately 100 feet wide, 300 feet long and 167 feet high. The building itself is approximately 450 feet wide, 800 feet long and 100 feet high, and is divided into waiting-rooms, dining-rooms, arcades with shops, offices for railroad officials, baggage-rooms, driveways, a concourse, train platforms, etc. There are also to be lighted several miles of tunnels and approaches, and large terminal yards. All told about 20,000 glower units will be required.

On account of the great variation in the architectural features of each room, no uniform arrangement of lamps was permissible, each room being a problem in itself. The spaces thus treated, with their approximate dimensions, are as follows:

	Width.	Length.	Height.
General waiting room	100 ft.	300 ft.	167 ft.
Seventh Avenue arcade	50	220	64
Men's waiting room	60	100	60
Women's waiting room	60	100	60
Restaurant	60	120	33
Lunch room	60	120	33
Concourse	60	450	90
31st St. carriage drive	50	530	65
33rd St. carriage drive	50	530	65

The remainder of the building offers nothing unusual in the lighting problem, and it is unnecessary to go into details at the present time. In the offices and corridors, the lamps will be located on the ceiling, no drop lights being used. A provision has been made for desk lamps where required. The shop lighting in the arcade will be a feature of this installation, and Nernst lamps will be used with a standard mirror reflector for the shop window lighting.

Production and Use of Mica.

The report by Mr. G. O. Smith of the U. S. Geological Survey on mica in 1905 shows that production was limited to North Carolina, Colorado, New Hampshire, Georgia, South Dakota and New Mexico in the order named. The total output of sheet mica for these states was 851,000 lb., with a total value of $185,900. Of this quantity North Carolina is credited with 669,000 lb., valued at $85,000. The increase in production over the previous year was largely in other states, while the larger increase in value may be accounted for in part by high prices reported by producers in those states. A decrease in the average price for the North Carolina product is due to the increasing proportion of small mica produced for electrical uses. The total production of scrap mica in the United States in 1905 was 856 net tons, valued at $15,255, an increase in value over the production for 1904. North Carolina's output of scrap mica for 1905 was 175 tons, valued at $2,375. The separation of the production figures for scrap mica and for the smaller sizes of sheet mica becomes more difficult as the use of these small sizes increases.

The production of sheet mica in 1904 was 668,358 lb., valued at $109,462, and of scrap mica 1906 net tons, valued at $10,854. Thus the value of the aggregated product of mica in 1905 was $201,155, as compared with $120,316 in 1904. The value of imported mica now used in the United States is twice that of the domestic article. In 1905 1,506,382 lb. of manufactured mica, valued at $352,475, and 88,188 lb. of cut or trimmed mica, valued at $51,281, were imported, making a total of 1,594,570 lb., valued at $403,756.

The three principal uses of mica are for electrical insulation, glazing and decoration. The first-named application probably leads in present importance. The increasing use of mica in electrical manufacture has largely modified the demand made upon the mining industry. Small sizes of sheet mica are used in the manufacture of insulators for lamp sockets, lightning arresters, switch boxes and fuse blocks. More important even is the extensive use that is made of composite mica, micanite, molded mica and other varieties of built-up mica sheets.

CURRENT NEWS AND NOTES.

CABLES IN CHICAGO.—It seems like an echo of old bygone days to read that two cable roads in Chicago were converted to electricity last week. But New York City can still boast of its stronger flavor of antiquity, and of the fact that it still has "bobtail" horse cars running.

PENALIZING OUTAGES.—At Rochester, N. Y., a cumulative penalty plan has been adopted by the municipal authorities in the new lighting contract. It is provided that if a lamp fails to burn, the city may deduct a sum equal to that which the company would have been entitled to receive if such lamp had been burning; but if a lamp is out for two successive nights a double penalty will be exacted, and if the lights are out more than two nights in succession, a penalty five times the amount will be deducted. Provision is made, moreover, that an employe of the company shall inspect the lamps twice each night, instead of once as under the present contract. In case an outside company secures the contract to deliver electricity to the city line, it is provided that duplicate machinery shall be installed in the transformer stations, as may be necessary to insure the continuity of the current. The board of contract can impose suitable provisions and penalties for interrupted service.

ICELAND CABLE.—Iceland will no longer be isolated from the rest of the world. The proposed cable to Iceland is to be laid from the Shetland Islands to Thorshavn, in the Faroe Islands, and thence to Seydisfjord, in Iceland. From the latter point there is to be a land line to Reykjavik. The cable is not expected to be completed until the autumn.

TELEPHONY IN PENNSYLVANIA.—The third annual convention of the Pennsylvania State Independent Telephone Association will be held in Allentown, Pa., on Sept. 11 and 12, 1906. The Pennsylvania Association has always made an excellent showing, not only at its home conventions, but at the national conventions. A Pennsylvania delegate was elected treasurer of the National Association, and it was a Pennsylvania company that secured first prize in the photographic contest for the best exchanges and equipment.

LIGHTNING DESTROYS WIRELESS.—The reports are very scant of damage done to wireless stations by lightning, but a special dispatch from Beaufort, N. C., of August 17 says: "Lightning struck the naval wireless telegraph station near Beaufort to-day. The lightning hit the high mast and the instruments and telephone connections were burned out. The naval clock was broken. Those in charge have not been able to determine whether the storage batteries and the generators have been entirely destroyed. No one was injured, although Electrician Short had a narrow escape."

TELEPHONY IN CANADA.—At the recent Halifax, N. S., meeting of the Union of Canadian Municipalities, the following resolution was adopted: "In the opinion of the Union of Canadian Municipalities, where a telephone company already charges its maximum authorized rate to the subscribers, being under the obligation of supplying the best and most modern instalment, it is unjust and illegal for the company to make an additional charge, under the pretense of supplying an improved instrument, called a long distance telephone." A resolution was adopted endorsing the request of the provincial legislature of Manitoba to the parliament of Canada, for authority to expropriate or purchase all the telephone lines in the province, and affirming the principle that similar authority should be given to the other provinces of the dominion. It was also unanimously decided to memorialize parliament to amend the legislation of last session so as to require the freest interchange of business between telephone companies, whether long distance or not. It was held that the recent legislation requiring the long distance lines to give connection to local and rival concerns did not meet the public requirements, and that in the interchange of business telephone companies should be placed in precisely the same category as railway companies.

NO USE FOR SAGE.—A recent article in the *American Machinist* comments on our recent strictures on Russell Sage, and apparently agrees with them; but thinks that Sage's real danger to humanity lay in his corrupting Dick Croker. We quote as follows: "The true conservative who simply insists upon satisfactory evidence of the wisdom of a proposed expenditure has his uses of course; but a man who simply possesses a talent for holding on to money until compelled to let go of it has no use so far as we can see. By the way, our contemporary whom we have quoted opposes 'tooth and nail' the municipal ownership of public utilities, and to judge from some things we have seen in its columns it should, to be entirely fair, charge the old-time backwardness and old fogyism of the elevated railroad management to the fact that it was privately owned—owned by men who (very properly, we think) regarded it as their property—held for the purpose of making money for its owners. The harm done by such men as Sage in blocking the wheels of progress and by others owning public franchises in corrupting and debasing municipal, state and national legislative bodies seems to escape the notice of our contemporary entirely when dealing with the question of public ownership of public utilities, and it seems able to see only balances made by accountants and designed to show whether or not publicly or privately owned utilities are the more economically managed." We had certainly overlooked the purity of the politicians.

ASCETIC ASPECT OF ACETYLENE.—At the recent acetylene convention in Atlantic City, Mr. A. C. Morrison presented a paper taking a very sombre and sober view of acetylene, and treated the subject in a manner far removed from the gaseous. Referring apologetically to the use made of electricity by the acetylene inventors, the paper said: "He has reached into the heavens and seized a thing—we call it electricity! The heat of the first fire has been increased by the very lightnings until the energy of flowing water, concentrated in the electric arc, would, if extended, melt the world again! Yes, we may say, Who is man? Whence came he? Be he animal or spirit, he is divine, because he can create. Lime yields to him! Carbon yields to him! They melt and coalesce, and through him alone they become one—and Nature never saw the like! Something new is born, and we call it calcium carbide! Is it like man? Is lime the body and carbon the soul? Do all things return to their elements? Is the Nirvana of the Hindoo, the absorption of the spirit into the great spirit of God, but a dream? Is calcium carbide to be destroyed that its spirit may escape? Is it tried in the fire of the electric arc that its soul may attain identity? 'Dust to dust,' says the Good Word, of the body. Lime came from water, and to water it shall return, and thus bony lime falling away like the bones of man shall release the spirit of Calcium Carbide—ACETYLENE! Acetylene!! Its identity attained! A new spirit marked by its individuality! Touch it but again with a spark from its creator, and it springs instantly back into glorious sunlight, its cycle complete. Therefore, may it glow and inspire by its presence a high regard among us, for it is a child of a hundred million years. In it we discover the spirit of material things, the spirit of living things, and a veritable cycle of Atomic Nature, a beautiful spirit, tried by fire, returning to its source, having served man well and attained its reward in SUNLIGHT." The repressed capitals are not ours.

THE CHICAGO SUBWAY is now handling freight as well as supplying an automatic telephone service. In the present equipment there are 67 electric locomotives and 400 trucks, and there are building fifteen locomotives and 250 trucks. The company has 40 receiving stations, connecting with the Erie, Alton, Rock Island, Wabash, Atchison, Great Western, Monon, B. & O., and St. Paul. Contracts have been made with the Eastern Illinois and Illinois Central. It is estimated that soon 30,000 tons of merchandise will be moved every 24 hours, which at an average of 60 cents per ton for 365 days would give a gross revenue of more than $6,500,000, from which the net income should be fully $5,000,000, before allowing $1,000,000 interest on $20,000,000 of indebtedness. Should the subway get one-third of the traffic teamed down town at a cost to the merchants of over $60,000,000 this would mean gross earnings of fully $20,000,000, and considerably more than $8,000,000 should be net. There is $40,000,000 stock. The ingenuity of the engineer who has planned and supervised the construction of the subway has been taxed to the utmost by conditions confronting him, on account of the many styles of buildings that had to be tapped to make connections with the tunnel. In New York and other Eastern cities many structures have been built which extend 30, 40 or 50 feet below the street surface, and such basements have been built in Chicago only recently, while others are being constructed in connection with new business houses now in course of erection in the loop district. These are facilitating the work of the tunnel engineers in making proper connections with the mercantile establishments that will enjoy the freight service of the tunnel company. Where the tunnel connects with a building whose basement extends only one story below the street grade, a turnout or bypass was constructed leading from the main tunnel to the inside of the curb, where it was made to connect with a shaft leading to the basement under the sidewalk. Specially designed elevators lift the cars to the basement floor, where, with the use of a turntable, they are shoved wherever desired. These elevators are tested to carry 30,000 pounds.

ELECTRICAL BUSINESS GETTING.—The Co-operative Electrical Development Association has issued in very attractive pamphlet form, the valuable paper by Mr. M. S. Seelman, Jr., which won the first prize of $500 awarded by the association for the best paper on business getting methods for central stations, the award being made on decision of the National Electric Light Association. In its present form, every central station manager ought to carry a copy in his pocket, and combine its regular perusal with his daily devotions. It is full of sound, practical, shrewd advice and is the outcome of experience.

LONDON UNDERGROUND ROAD.—A cable dispatch from London of August 18 says: "Londoners are discontented with the determination of Sir George Gibb to increase the fares on the Metropolitan District Railway, when the returns show a large increase of what he calls unprofitable business. The truth seems to be that, while the underground railways have been greatly improved by electric power and new carriages, there has been a considerable increase in operating expenses, for which passengers will have to pay in higher fares. The competition between electric railways and motor omnibuses is one of the factors in the complex problem."

TELEPHONY IN MADEIRA.—U. S. Consul Maxwell Blake, of Funchal, reports that a telephone system is badly needed on the island of Madeira. The country contains 150,000 people, one-third of the number residing in Funchal, a rich and prosperous city, the trade of which is carried on by Portuguese, English and German merchants. The place is also a winter resort, with numerous hotels and villas occupied about six months of the year. The different business enterprises carry on trade throughout the island, which is rather mountainous, so that communication is difficult. The island is 36 miles long and 3 miles wide. A franchise for a telephone system might be secured from the Lisbon Government, especially if Portuguese capital were interested in the enterprise.

CHILEAN EARTHQUAKE.—The Republic of Chili was visited last week by severe earthquake, and as a result of that and the subsequent fire, Valparaiso suffered great damage, while other places like Santiago also suffered severely. The directors of the Electrical Street Railway Company of Valparaiso have sent a cable message to the German Oversea Electrical Company, owner of the majority of the stock of the Chilean concern, that its water and power plants, machinery, equipment, tracks, cars and carsheds at Valparaiso have not been injured by the earthquake or fire. The dispatch adds that the workshops of the concern, the reserve power buildings, the storage batteries station and the arc lamps and wires have been considerably damaged. All the officials of the company escaped injury. There are no other reports as to the electrical industries, and the cables have remained in operation.

WIRELESS CAUSES WRECK.—Reports from England state that the fourth sitting of the court martial on the loss of H. M. S. *Montagu,* held at Portsmouth, was rendered particularly interesting by the fact that the two prisoners, Captain Adair, commanding the unfortunate ship, and Navigating Lieutenant Dalban, read their defenses. Captain Adair explained that his orders were to carry out wireless telegraph tests in connection with the Scilly Island, and he had endeavored to get into touch with Scilly, but the distance was too great for satisfactory communications. He therefore decided to proceed ten miles nearer and telegraphed the commander in chief at Devonport for permission to do so. As that permission had not arrived, he weighed and proceeded ten miles. Ten minutes later the permission arrived. The result of the difficulties in which he became involved was shipwreck in a heavy fog off Lundy Island.

THE ALASKAN CABLE.—It is reported that commercial receipts from the Alaskan cable and telegraph lines amounted to $24,000 in July, which is $2,000 in excess of the amount collected by the United States in any previous month. The official despatches sent during the month would have cost $12,000 had they been paid for at the commercial rates. This rapid increase in the demands upon the Alaskan cable and telegraph system will be met by the Government by duplexing the cable. The cable-ship Burnside, which is to install the duplexing apparatus at the Alaskan end of the cable, will probably leave Seattle about September 1. It will carry 200 miles of new cable, which has just been shipped from New York, for the extension of the cable service south of Ketchikan. This extension will be effected by tapping the line from Sitka to Juneau at Cape Fanshaw. From that point a branch line will be extended down to Wrangell, then to Hadley, on Prince of Wales Island, and thence to Ketchikan, which is only sixty miles from Port Simpson, the English town which is to be the terminus of the Grand Trunk Pacific Railway.

EUROPEAN MUNICIPAL OWNERSHIP.—A statement has been issued on behalf of the sub-committee of the Public Ownership Commission appointed by the National Civic Federation to investigate public and private ownership of public utilities in European countries, as to the result of the investigation. The report states that nearly every large gas, electric light and street railway system in Great Britain has been examined, and that the work of the committee is nearly complete. The statement says: "The European investigation has extended over six months, and from ten to thirteen men have been engaged upon the work most of the time. A detailed examination has been made of seven gas plants, seven street railway undertakings, and ten electric lighting systems, about equally divided between municipal and private operation. In addition, information has been gathered regarding the history, development, and results of the various acts and franchises that have been passed. The various methods of public control as distinguished from public operation, have been carefully examined, and an attempt has been made to find upon what conditions and under what restrictions municipal and private management has produced its best results. The report of the commission, when finally published, promises to attract almost as much attention in England as in the United States, for the discussion of the question of municipal ownership is just now attracting unusual attention everywhere in Great Britain, where the burden of taxation due to unprofitable municipal undertakings has of late grown enormously.

THE USE OF GAS.—According to data given by the *Progressive Age,* the output of gas in Paris, France, in 1855 was 1,439,973,000 cu. ft. and in 1905 13,946,711,000 cu. ft., which would indicate an annual average increase of 250,000 cu. ft. for 50 years, although the actual percentage increase over 1904 was 4 per cent. or 5.19 and 7.62 per cent. for the two previous years due to the reduction in price, the average price now being $1.46. This means that Paris used about 5,000 cu. ft. per inhabitant per year as compared with 1,165 cu. ft. in 1855, 3,800 cu. ft. in 1889 and 4,400 cu. ft. in 1900, and gives a fair idea of the increasing rate at which people are using gas. These figures, however, do not compare unfavorably with the United States cities such as Philadelphia, 6,600; Baltimore, 4,769; Denver, 4,790; Cincinnati, 5,500; Detroit, 6,150, etc. Also note Birmingham, England, 8,300 or German cities such as Bremen, 8,530; Hanover, 8,400; Hamburg, 7,314; Munich, 3,528, etc. Some French statistics recently published declare that Lyons citizens used but 2,260 cu. ft. per inhabitant; Marseilles, 1,940 and Bordeaux, 2,719; Glasgow, Scotland, uses 6,449 cu. ft.; New York City uses about 6,800. Compare with this the Italian cities of Milan with 3,400; Turin, 3,000; Naples, 700; Rome, 1,660, and Venice, 970. All these cities have, or should have, progressive management and show how directly the quantity of gas used depends upon the price. Again, during about a decade the percentage increase per year of Italian cities have been: Milan, 8.9 per cent; Rome, 4.9 per cent; Naples and Turin, 1.4 per cent. In England: Sheffield, 5 per cent; Birmingham, 4.8 per cent; Manchester, 3.2 per cent; Edinburgh, Scotland, 3.1 per cent, and Glasgow, 4.2 per cent. In the United States the growth is much more apparent: Philadelphia, 9.7 per cent; Denver, 12 per cent; St. Louis, 24.7 per cent; Detroit, 58 per cent; New Orleans, 13.3 per cent; Cincinnati, 7.6 per cent, and Baltimore, 5.2 per cent. The use of gas has increased particularly in the Central West.

LIGHTING IN GREECE.—Mr. John B. Jackson, U. S. minister to Greece, reports, under date of June 25, that the expected bill for the taxation of lighting materials was presented in the Chamber of Deputies June 24. This bill provides for the taxation of the amount of gas and electricity used for lighting purposes (not when used to furnish motive power, etc.), and for various other lighting materials, including gasoline. On this last article the tax is to be 60 lepta (centimes) the Greek oke, which would seem to be rather high. It is to be applied as a measure of protection to gasoline of whatever origin.

TWO CENT RAILWAY FARE.—While the enforced two cents per mile steam railroad fare in Ohio has resulted now in an increase of traffic to a marked degree, it is said that the adoption of the two cent passenger tariff by the Pennsylvania Railroad is regretted by the traction companies whose lines parallel the railroad. Reports from the companies in a similar position in Ohio show that the two cent per mile rate in the state has resulted in a curtailment of traction earnings. It is argued however, that the increase in population and the convenience of the street cars will prevent any real serious result to the interurbans.

ENGLISH AGRICULTURE.—The British *Electrical Magazine* reports that the development of the suction gas plant and the successful production of nitrates from the air by electrical means are matters which are attracting the attention of the agricultural section of the British community. The development of the former on a commercial scale may bring the latter directly within the reach of the farmer who tills the land upon an extensive scale. A combination of suction gas plants and gas dynamos will at once give him a cheap and handy method of generating electrical energy. The standardization of the gas engine was accomplished many years ago; consequently the matter of the prime mover is practically settled.

LEGALITY OF ELECTRIFICATION.—The point is raised by the *Wall Street Journal* that steam railroads may find it illegal under Section 5,258, of the revised statutes of the United States, to change to electric traction, because the act says "operated by steam." As a matter of fact, such roads will still be "operated by steam," with few exceptions, even if electricity turns the wheels. The following remarks are made: "The problem is two fold, namely: First, Can these systems be operated by electricity without losing the franchise granted by the act of congress? Second, Can congress be persuaded to amend the act to as to permit the use of electricity instead of steam as motive power without imposing burdensome obligations in payment for the new franchise? Before these problems are solved will the great railway systems venture to adopt electricity as motive power of interstates lines?" Electricity is not a motive power. It is an agent for distributing motive power.

KELVIN ON RADIUM.—A special cable dispatch from London, of August 18, says: "*The Times* comments editorially this morning on the radium controversy aroused by what it considers a too facile acceptance by the British Association of the proposition that the evolution of one element into others is an established fact. The *Times* objects seriously to Sir Oliver Lodge's attempt to dispose of Lord Kelvin's dissent from the proposition, by intimating that Lord Kelvin was not qualified to express an opinion touching upon elemental transmutation, inasmuch as he had not read what its advocates had submitted to the British Association. The *Times* says that it is ridiculous to suggest that Lord Kelvin would offer in print an opinion that was not fully considered and well grounded. It adds: It has become the fashion to accept the transmutation of the elements, and various workers are vying with one another in spinning cobwebs about it, without having bestowed upon the facts anything like the amount of critical industry required to give their novel theories validity. The thing corresponds to a certain attitude of mind common among scientific people at the present day. But subjective satisfaction is one thing, and conclusive proof is another. Lord Kelvin does not find the proof. It is pure assumption that he does not know what others think of the evidence, and it is not a very courteous assumption."

EXPOSITION OF SAFETY DEVICES.—The American Institute of Social Service will hold in New York City, in January next, an exposition of devices for safeguarding the lives and limbs of working men and women, and for preventing accidents under the ordinary conditions of life and labor to which the general public is exposed. This will be the first exposition of the kind in this country. As far back as 1889 there was a German Exposition for the prevention of accidents. In 1893 an exposition of this nature was held in Amsterdam, and since then there have been several similar expositions in continental Europe and in Canada. As an outgrowth of these national movements there have been organized several Museums of Security; one at Vienna in 1890, one at Amsterdam in 1893, one at Munich in 1900, one at Berlin in 1901, and one at Paris in 1905, and Russia, which we are inclined to look upon as semi-barbarous, has recently established a museum on a large scale in Moscow. The exhibition will include: Section 1, Models, photographs and drawings of scaffolding, as well as the personal equipment of workers in building trades. 2, Protective devices for boilers, water gauges, signal apparatus, boiler and pipe valves; also protective devices for electrical machinery and acetylene apparatus. 3, Protective devices for motors and power transmitters, devices for turning on power and shutting it off, belt connection, couplings, etc. 4, Fire protection and the prevention of explosives. 6, Mining and quarrying; devices in use on stone crushing machinery, etc. Storing of explosives. 7, Metal industry; safety devices for metal-working machinery. 10, Safety appliances for elevators and hoisting apparatus models. 12, Personal equipment of workingmen; protective spectacles, respirators, suits, etc. 18, Cooking; demonstration in heating food; models, plans, photographs. Requests for information regarding space should be made to Dr. William H. Tolman, Director, 287 Fourth Avenue, New York.

NEW YORK-CHICAGO ELECTRIC.—Note was made in these pages last week of the proposed electric road between New York and Chicago, to cost $150,000,000. Mr. Joseph Ramsey, Jr., ex-president of the Wabash Railroad, has made a few further statements about this projected Keystone Air Line Railroad, which is to cut over 100 miles from the distance between New York and Chicago, and beat all the existing roads in the matter of grades and curves. Dispatches from Harrisburg, Pa., where papers of consolidation had been filed, announced that the aggregate mileage of the three constituent roads, as set forth in the papers of association on which a charter was issued, amounted to only eighty-five miles and that the roads did not connect. Mr. Ramsey said it was true that in the original papers incorporating the three roads their routes are as described in the dispatches from Harrisburg, but that as they stand on paper at present the routes of the roads make a continuous line and that their charter rights and franchises cover the same continuous routes as the surveys. The three roads are the Indiana, Clearfield & Eastern, the Allentown, Tamaqua & Ashland, and the Brush Creek & Crow's Run. "It would have been the height of folly," Mr. Ramsey said, "to have covered our routes exactly in the papers of incorporation, for that would have given our scheme away at once. The Harisburg dispatches refer to the original papers and describe the lines, as they then stood, correctly. The laws of Pennsylvania, however, give the directors of a road the right to extend it at will. Too much has been said about this new road already, but I may add that all the surveys have been made for the stretch east from Pittsburg." Mr. Ramsey said that the new line would be electric, in the sense that provision would be made for the use of electric locomotives, which he was confident would be found entirely practicable by the time the road is completed. Motor cars would not be possible, he said, because of the impossibility of adapting that type of electric traction to long-distance freight traffic. Since the scheme outlined above was made public, a second company has announced its intention to construct an electric railway from Chicago to New York and also on to Boston. This latter company, which is called the New York, Boston & Chicago Air Line Company, is capitalized at $10,000,000. The cost of construction is estimated at $75,000 a mile, and the distance between Boston and Chicago by the bee line it is proposed to follow is estimated at 961 miles.

The Power Plants of the United Electric Light Company, Springfield, Mass.

THE generating equipment of the United Electric Light Company, of Springfield, Mass., is characterized by a number of interesting features which differ considerably from the usual central station layout in New England. The company is fortunate enough to be able to obtain from 60 to 65 per cent of its energy from water falls, and it has altogether three generating plants, only one of which is a steam driven station. The company serves Springfield, West Springfield and Longmeadow, its circuits being available to upwards of 90,000 people. As far back as 1882 electricity for lighting was sold in Springfield. The original station contained two 5-hp Fuller and two 10-hp Weston arc dynamos, belt driven by a 60-hp Buckeye engine. The load consisted of 30 arc lamps, operated in two circuits. To-day the company's stations offer an aggregate capacity of nearly 12,000 hp, and further changes from the present to even more modern equipment are planned.

The power plants are known, respectively, as Springfield Station, No. 1 (steam power); Indian Orchard Station, No. 2 (water power); Birchem Bend Station, No. 3 (water power).

The accompanying drawing, Fig 2, shows the general operating scheme of the system. All the stations are connected by two two-phase circuits of No. 4-0 copper. One of these circuits is usually given up to motor service and the other to lamps, but the generators in all three stations are arranged so that by throwing an oil switch, power may be supplied to the lamps or motor lines as the load demands. The transmission voltage is 5,500, the circuits forming a triangular double belt line. From station No. 1 in Springfield to No. 2 at Indian Orchard the distance is 7 miles by way of the Berkshire Street line; from No. 1 to No. 3 at Birchem Bend the distance by way of the St. James Avenue line is 6 miles. Between Indian Orchard and Birchem Bend the distance is 2 miles.

The lines were arranged in the above manner for the following reason: In case of an overhead or underground trouble on the St. James Avenue line, the station instruments would immediately detect the trouble, and the proper oil switches could be thrown and the line cut out, the current flowing meanwhile uninterruptedly from the stations through the other two sides of the triangle. About two miles of underground construction is in service on each of the lines from the Springfield station No. 1 east. In locating trouble the overhead portion of the line may be cut away from the underground by means of switches in the manhole where the two parts are joined, and in that way time is saved and the trouble quickly found.

In addition to the lamp and motor wires running between stations No. 2 and No. 1 there are at present 18 arc lamp wires carried on the same pole line from Brush arc machines located at Indian Orchard to the street and commercial load in Springfield. The poles are 40 ft. in length, on the average, and the disposition of circuits is as follows: Each pole carries five cross arms, the two upper arms being four-pin arms and the three lower ones, standard eight-pin arms. The two 5,500-volt circuits are carried on the two upper arms and the arc lines on the eight-pin outfits. The line between Indian Orchard and Birchem Bend is all overhead construction. Due to the flexibility of the transmission line arrangement, the circuits have been remarkably free from interrupted service since the three stations have been in operation all together, only one or two complete shut downs being on record.

Station No. 1, illustrated in Fig. 1, is located at the foot of State Street on the east bank of the Connecticut River, adjoining the main line of the New York, New Haven and Hartford Railroad between Springfield and New York. Here water may be easily obtained for condensing purposes. The station is used as a distributing centre for a large portion of the company's electrical output.

FIG. 1.—TURBO-ALTERNATOR IN SPRINGFIELD STATION NO. 1.

The station building is a brick structure 164 ft. long and 75 ft. wide. At the north end is a boiler room 59 ft. 6 in. by 60 ft. 6 in.; the central portion is an engine room 106 ft. 10 in. by 75 ft., while in the northeast corner is a transformer room 59 ft. 6 in. by 32 ft. Between the station building and the New Haven tracks are two coal storage bins having a capacity of about 4,000 tons. Beneath the engine room is a basement about 10 ft. high in the clear, containing the condensing and wet vacuum pumping equipment, filter pump and tank pump. All the incoming, local and outgoing circuits are controlled from a wide switchboard gallery which occupies what amounts to a second story space along the entire west wall of the station.

Coal arriving at the plant is taken from the cars by an electric locomotive crane, shown in Fig. 3, and dumped into one of the bins previously mentioned. Ordinarily one of the bins is held in reserve against emergencies. The coal handling bucket, hoist and traveling car were supplied by the Industrial Works of Bay

City, Mich. The bucket has a capacity of 1,100 lbs., and the apparatus can deliver at least 30 tons of coal per hour to the crushing and conveying mechanism of the power house proper. The hoisting crane motor is of the 500-volt direct-current type rated at 50 hp. This size was used to make sure that the apparatus could not be overloaded to the point of breakdown, although a smaller size would be capable of performing the normal work.

From the crusher the coal is taken by a belt conveyor to the top of the coal conveying machinery house and delivered to a weighing machine which automatically records and delivers loads of 500 lbs. to a belt conveyor beneath. This conveyor delivers the coal to the boilers by means of an adjustable carriage with downward projecting spouts which pass back and forth in front of the boiler hoppers and discharge into them at the proper points. The hoisting motor is a 10-hp machine, the crusher motor, 20-hp and the conveyor motor 10-hp. The conveying apparatus was furnished by the Exeter Machine Works, of Pittston, Pa. The operating cost of unloading the coal, crushing it, weighing it and delivering it at the furnaces is about 3 cents per ton.

The boiler plant consists of eight 400-hp Hazelton boilers ar-

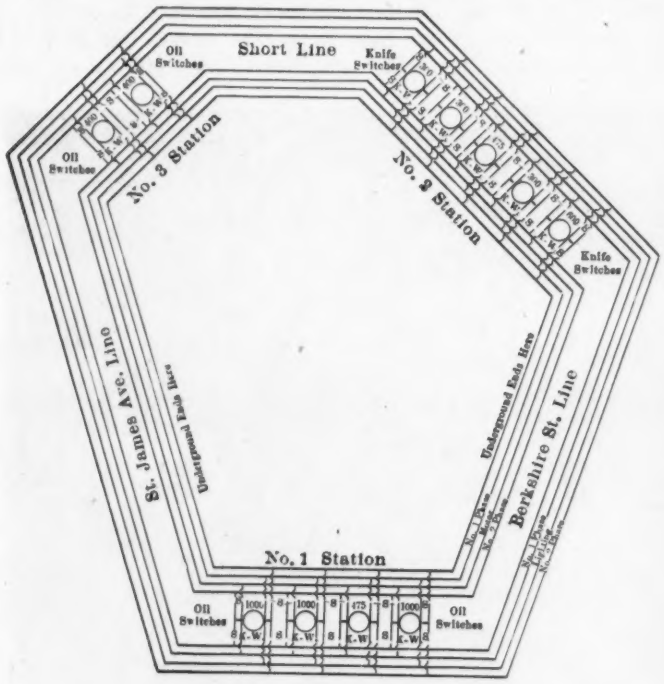


FIG. 2.—GENERAL SCHEME OF DISTRIBUTION SYSTEM.

ranged in two batteries of four units each. There are about 4,800 sq. ft. of heating surface per boiler. As the coal conveying apparatus occupies considerable space in the centre of the boiler room, the steam gauges are piped down to the level of the attendants' heads, for greater convenience in reading. In connection with the boilers a 3,000-hp National feed water heater, a 1,500-gallon per hour Jewell gravity feed water filter, a 14-in. by 18-in. by 12-in. Warren single feed pump and one 7½-in. by 7½-in. Warren filter pump are installed. The boilers are all equipped with the Murphy furnaces, each unit having its own stack of steel, 48 in. in diameter and 70 ft. high above the grate. The company has found that this furnace has greatly increased the efficiency and capacity of the boilers and that it absolutely overcomes the smoke nuisance.

The engine room contains three 1,000-kw Westinghouse-Parsons steam turbines, two-phase, 60 cycles, 5,500 volts, running at 1,800 r.p.m. The exciter sets used with each turbine are Westinghouse standard 8½ in. by 8½ in. engines direct connected to 25-kw 125-volt generators. The condensing apparatus for each turbine was built by the Deane Steam Pump Company, of Holyoke, Mass., and it consists of one 15 in. by 30 in. by 18 in. vertical wet vacuum pump operating at 28 r.p.m., and one 10 in. by 22 in. by 18 in. rotative dry vacuum pump operating at 90 r.p.m. The water which is lifted from the river, 18 ft. below, in summer has a temperature of about 70 degrees. The vacuum is maintained at about 28 in. throughout the year. A view of one of the 1,000-kw Westinghouse-Parsons turbines is shown in Fig. 1.

In the same room with the turbines is one 22-in. by 44-in. by 60-in. 800-hp cross compound Corliss engine operated at 70 r.p.m. Driven by a line shaft beneath the switchboard gallery are the

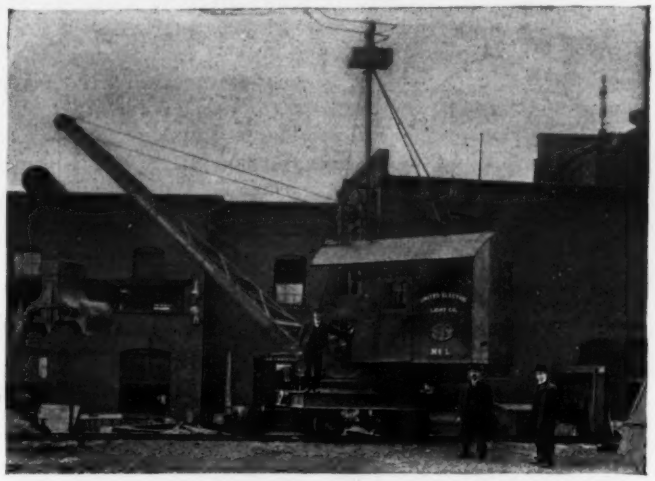


FIG. 3.—COAL HANDLING CRANE, UNITED ELECTRIC LIGHT CO., SPRINGFIELD.

following machines: One 500-kw, 500-volt General Electric direct-current generator coupled direct to the line shaft; one 475-kw, 5,500-volt, two-phase, 60-cycle Stanley generator, belted type, and an independently mounted 500-kw, 500-volt Westinghouse rotary converter.

In the gallery above the engine room are located two 40-kw and two 50-kw 5-ampere Brush arc generators, which are belted to the line shaft directly below. Two more 500-kw Brush arc machines are direct connected to a 150-hp General Electric 2,400-volt, two-phase induction motor. In a few weeks the four arc

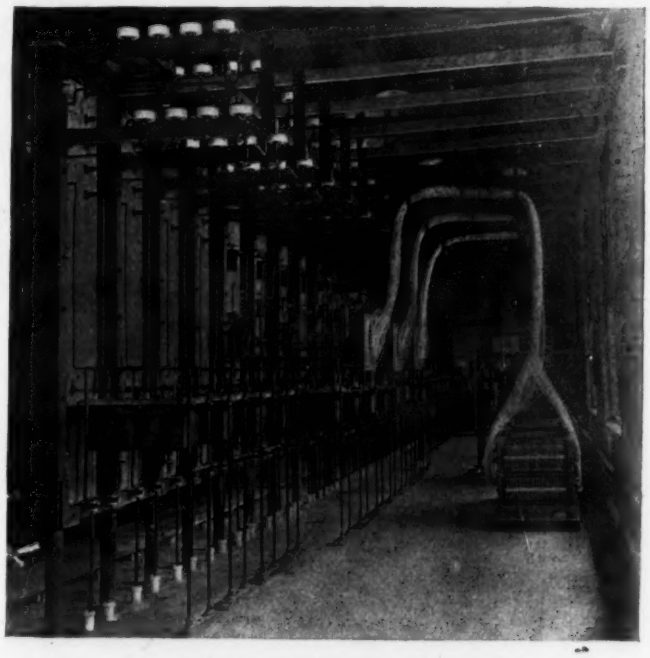


FIG. 4.—REAR OF 5,500-VOLT SWITCHBOARD, STATION NO. 1.

machines mentioned above will be taken off the shafting and direct connected to motors of the type just described.

The steam piping at station No. 1 is exceedingly flexible, and was laid out with unusual care by the mechanical and electrical superintendent of the company, Mr. Fred N. Fowler. Each battery of four boilers occupies one side of the boiler room. A 6-in. live steam supply pipe leads from each boiler into the nearest of two parallel trunk lines running longitudinally through the boiler room to the engine room, each supply pipe being properly valved. The trunk lines or headers start with 6-in. pipe, increasing to 12-in. diameter at the partition wall separating the two rooms. A 12-in. stop valve in each line is installed on the engine room side and the two leaders then unite in a 16-in. main from which lines are carried to the various engines, pumps and turbines. The pumps

are supplied by a 6-in. auxiliary line which decreases to 4 in. at the last pump. The turbine supply pipes are each 6 in. in diameter, and the turbine exhausts are 28-in. pipe, with 24-in. free exhausts. The live steam for the Corliss engine is supplied

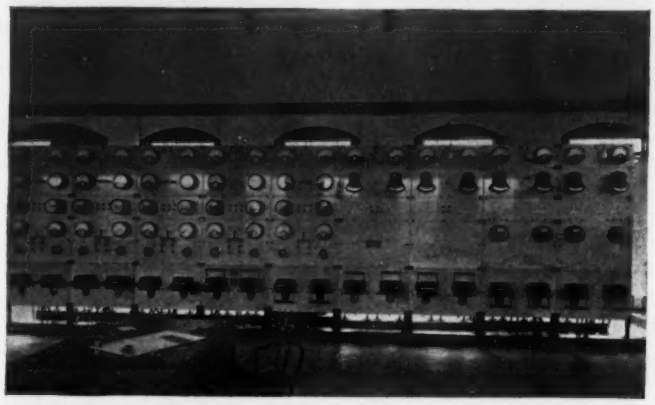


FIG. 5.—5,500-VOLT SWITCHBOARD, INDIAN ORCHARD STATION, NO. 2.

through an 8-in. pipe, and the exhaust is through a 20-in. pipe, with a 16-in. free exhaust.

The condensers are of the jet type, water for boiler feed being taken from the hot well, filtered and then pumped through the heater to the boilers. Injection water is drawn from the river, and the boilers may be fed by city water if desired. All of the auxiliaries exhaust through the feed water heater, and an extensive system of by-passing is in service to enable apparatus to be temporarily cut out of service for inspection or repairs. The piping was supplied by the Lumsden and Van Stone Company, of Boston, and the insulating covering by the H. W. Johns-Manville Company, of New York.

The 475-kw Stanley generator is used in times of high water to drive the Brush arc machines and the General Electric 500-kw generator. When the water supply at stations No. 2 and No. 3 is inadequate the 800-hp Corliss engine handles this load. George's Creek coal costing about $4.75 per ton is burned at the plant, and the average consumption is about 3 lbs. per kw-hour.

The switchboard gallery at station No. 1 contains one 16-panel, 5,500-volt board upon which is received the current from stations No. 2 and No. 3, and the generators located in station No. 1; one 13-panel, 2,400-volt distributing board which controls the incandescent lighting circuits of the company; a 500-volt, direct-current power board and an oil switch and circuit breaker board which is inserted between the 5,500-volt board and the transformers which reduce the potential to 2,400 for local distribution. All of the step-down lighting transformers are located in a fire-proof room, as mentioned above; there are six 150-kw, six 250-kw, and two 120-kw units. Each phase is provided with a separate panel on the 5,500-volt receiving board, and on the rear are two sets of bus bars for the motor and the lamp circuits. A space of nearly 10 ft. is allowed in the gallery between this switchboard and the wall nearest it. The local distribution from station No. 1 consists of 2,400-volt, single-phase, 60-cycle current for lamps; 500-volt, direct-current; 6,000-volt direct-current for arc circuits; 110-volt, direct current for charging automobiles, and 5,500-volt, two-phase current for motor. The largest motor on the system is a 400-hp machine at Indian Orchard. The largest transformer has capacity for supplying 600 lamps, and the largest single-phase motor in service is rated at 15 hp. Station No. 1 is equipped with a 20-ton hand-power traveling crane.

In a test of the steam consumption without superheat at the Westinghouse Company's works, one of the 1,000-kw turbines gave the following results:

Load, per cent.	Steam pressure, lbs. per sq. in.	Vacuum, in.	Water, lbs. per b.hp. hr.
50	152	27	15.99
75	153	29	14.78
100	150	27.1	13.58
150	141.8	26.5	14.58

Station No. 2 is located at Indian Orchard on the south bank of the Chicopee River. It is a brick building 210 ft. long by 50 ft. wide and is supplied with water through a canal 1,300 ft. long, 50 ft. wide and 8 ft. deep. There are eight intake gates at the head of the canal, of which one is 20 ft. wide, two are 10 ft. wide and five 3 ft. wide. The spillway is 100 ft. long. The plant is located at the extreme end of the canal, and the effective head of water is 36 ft. The water is delivered to four pairs of 36-in.

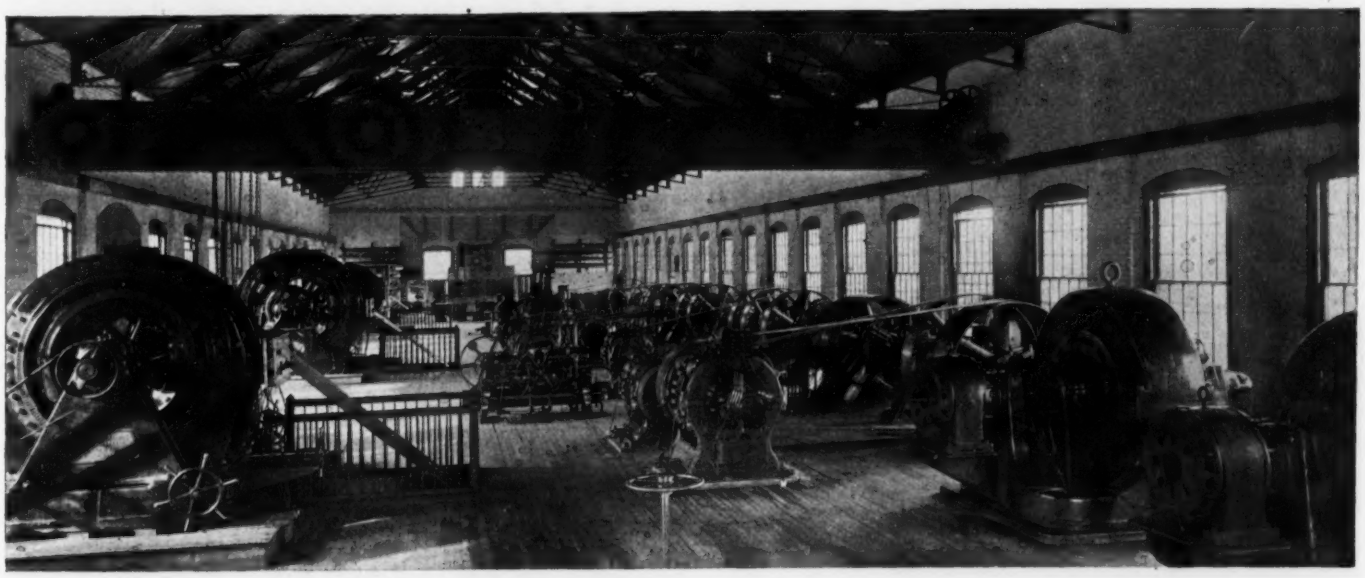


FIG. 6.—INTERIOR INDIAN ORCHARD STATION (NO. 2 PLANT).

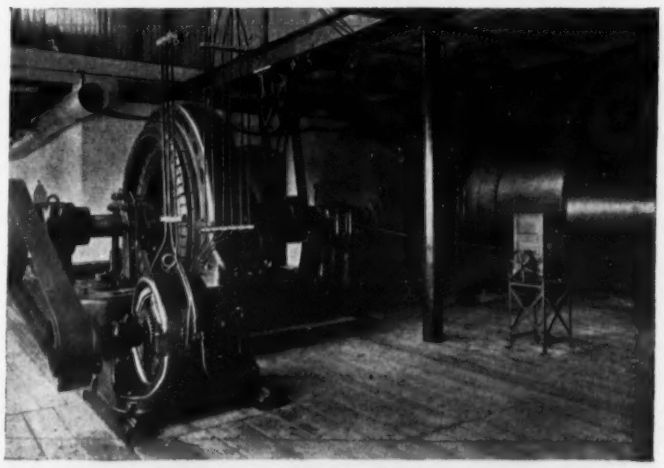


FIG. 7.—600-KW UNIT, INDIAN ORCHARD STATION.

McCormick horizontal turbines having four head gates with 13-ft. openings, and thence through four steel penstocks 11 ft. in diameter and 225 ft. long. The turbines are located in the base-

ment of the station, and are connected to the tail race by draft tubes 6 ft. 6 in. in diameter and 16 ft. long.

Turbine No. 1 is belted to two 300-kw Stanley, 5,500-volt, two-phase induction alternators. The next turbine is belted, one end to a quill shaft, and the other end to a 300-kw Stanley alternator. The third turbine is belted, one end to a quill shaft and the other end to a 475-kw Stanley inductor alternator. Friction clutches provide that all three of these turbines may be connected when it is considered desirable. The fourth turbine is set in the basement at right angles to the other three, and is direct connected to a 600-kw, 5,500-volt, two-phase Westinghouse generator running at 212 r.p.m. The latter machine is regulated by a type C Lombard governor, a type B Lombard governor being used for the first three turbines. The 600-kw machine drives a 25-kw exciter at 600 r.p.m. by a belt connection. All of the generators except the last named large unit are installed on the ground floor of the station above the basement, but it is probable that in the future the direct-connected machine will be supplemented by others of that type which will replace the belted units. The views given in Figs. 5, 6 and 7 show the exterior and interior of the Indian Orchard Station, its main switchboard and machinery. The compactness of the direct-connected turbine installation is worth noting.

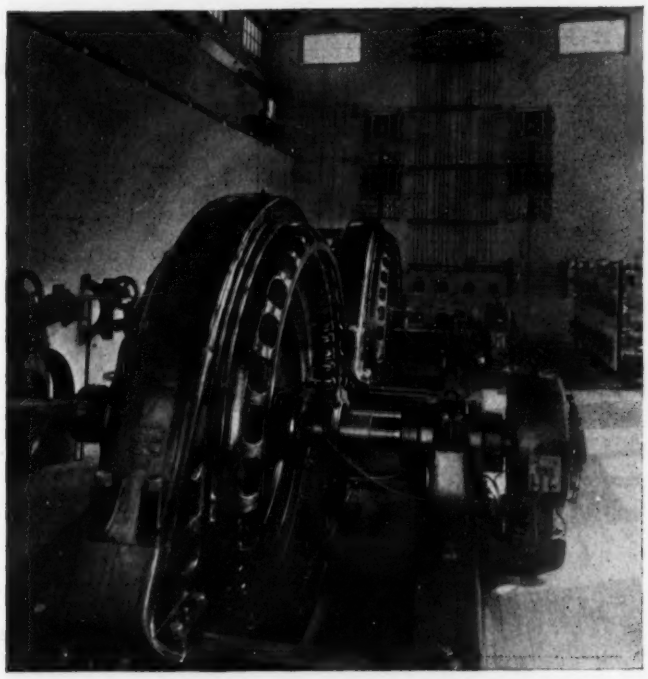


FIG. 8.—INTERIOR BIRCHEM BEND STATION, NO. 3.

On the north side of the Indian Orchard Station is a counter shaft to which are belted four 50-kw and eight 40-kw 5-amp. Brush arc machines used for street lighting. These machines may be connected to the quill shaft by friction clutches. At one end of the station are two 500-volt rotary converters used for supplying power to the Chapman Valve Manufacturing Company and the Springfield and Eastern Railroad. In cold weather the building is heated by a 40-hp boiler connected with a Buffalo fan and duct system. The switchboards for the alternating-current apparatus and the local street lighting system are located at the west end of the building. The alternating-current board, which is shown in Fig. 5 consists of five generator and four line panels. The local lighting board has two panels. Near it stands a 24-circuit arc board and a four-panel transfer board equipped with oil switches and lines leading to No. 3 station. The rotary converters are controlled by a four-panel switchboard at the opposite end of the building. In the basement at Indian Orchard are installed two 300-kw and two 250-kw transformers for the rotaries, one 120-kw Stanley and one 75-kw Westinghouse transformer for local lighting. The lightning arresters of station No. 2 are installed behind the switchboards at the west end of the plant and are identical with the equipment at No. 3 station. As is true of all of the plants of the company, sound-proof telephone booths are located near the switchboards.

The Birchem Bend Station, No. 3, which is the most recently built complete plant of the company, is also located on the Chicopee River. The plant is housed in a brick building 65 ft. long by 34 ft. wide, and it is equipped with 800 kilowatts in generator capacity.

The dam across the river is 241 ft. long, 14 ft. high, and it is equipped with 18-in. flash boards, so that the effective head is 15 ft. The dam is built of stone masonry, with a concrete and vitrified brick apron. There are six head gates 5 ft. by 6 ft. each; the spillway is 60 ft. long, and the canal is 270 ft. long and 50 ft. wide.

In the bottom of the canal are located two sets of four 39-in. McCormick turbines with shafts extending through the wall of the canal to the generator room, which is illustrated in Fig. 8. Direct connected to each wheel shaft is a 400-kw Westinghouse revolving field generator wound for 5,500 volts, two phase with a 14½-kw, 125-volt exciter mounted on the end of the shaft. The normal generator speed is 124 r.p.m. There are two switchboards in this station; one contains two generator and two line panels, which feed the current into the belt lines referred to; the other consists of a two-panel transfer board equipped with oil switches, by means of which either line going from this station to No. 1 or No. 2 may be cut out, or No. 3 station itself may be cut out from the belt line, and repairs made if necessary without the flow of current around the triangle being interrupted.

The lightning arrester equipment on each of the 5,500-volt wires going out of the station consists of two 100-amp. choke coils and six S.K.C. indoor type arresters. The ground wire in each case is connected to a wrought iron pipe running through earth to water. This equipment has been in use about three years, and has given good protection.

The general method of operating the stations is to get as much of an output as possible from the water power plants with the steam plant as a reserve. During periods of good water the two water power stations will take care of the day motor load and the street lighting, and the steam plant is called upon to supply current only at the peak. In the winter months, however, the steam plant is called upon to help out nearly every day and evening, on account of the heavy load conditions.

The No. 3 station is run at its full capacity all the time except for a few hours on Sunday, when the machines are shut down. looked over and cleaned up. Only two attendants are necessary at this station, one for day and the other for night service. At station No. 1 and station No. 2, three shifts of men are necessary to care for the large amount of apparatus installed, and to watch the load conditions so that extra machines may be thrown upon the system when necessary. There are two men on each shift at No. 2 and they work eight hours a day seven days a week. In the early morning hours sufficient power is generated at the No. 3 station to keep the alternating current bus bars supplied up to about 6.30 a. m.. and then the load increases rapidly. The units at the No. 2 station are then started until enough are in service to carry the day load. In case of low water or extreme load conditions, a steam turbine is started in place of the water wheels, and then as the load decreases the steam units are dropped off first, and then the water-driven units at No. 2 station, until No. 3 station is again carrying the whole load.

In actual operation the triangular transmission lines act essentially like the bus bars of a single station. Recording ammeters are used on the arc circuits at the No. 1 station in the heart of the city of Springfield, and the whole system is tied together so well by telephone that its operation is greatly simplified in comparison with plants not well equipped in this respect. Although the line potential at Springfield is low compared with that of transmission systems where greater distances are traversed, the installation is interesting because of the admirable way in which the different plants work together, and the illustration the plants afford of power station design progressing in harmony with the broader developments of the central station industry.

The United Electric Light Company is one of the most progressive in New England in the matter of new business getting, and an article describing the company's work in this important field was published in the Electrical World in January of this year, under the serial title of "Central Station Economics in Massachusetts." Its officers are: President, Robert W. Day; treasurer, W. A. Lincoln; manager, W. L. Mulligan.

Long Span Pole Lines.

BY A. J. BOWIE, JR.

STEAM auxiliary electric plants may be found in many stations to-day, which normally receive their entire power supply from electric transmission circuits. This even occurs where the steam plant has been constructed at the same time as the sub-station, with the express idea of providing for shutdowns of the transmission system. Where it is very important to have a continuous supply of power, steam is always kept up in these stations.

On looking into the reason for precautions of this nature, it is apparent that it is not with a view of guarding against the effect of damage to the generating or transforming plant, but practically solely to afford protection against the consequences of damage to the transmission lines—the weakest part of the system, though often more expensive than all of the rest of the investment in the entire plant.

All other parts of the system may be properly protected and carefully watched, but the line is exposed to most unfavorable conditions in both these respects. The price which can be obtained for electricity depends largely on the certainty of continuous supply. Where it is necessary to build new steam plants for auxiliaries for transmission sub-stations, it is evident that the value of transmitted power for certain industries is greatly decreased.

Line failures in general are attributable to trouble with the insulators, trouble from short-circuits caused by tree branches, or by birds getting across the line or by fires, and trouble from malice. Laws have been quite effective in preventing trouble of the last kind. A greater distance between wires is generally regarded as more beneficial from the practical standpoint of avoiding short-circuits than harmful, owing to increased induction. Increased voltages make this, as well as the proper clearing of the right of way, especially desirable.

Hence, when all reasonable precautions are taken, the troubles on a transmission system may be largely reduced to insulator troubles. To obviate these difficulties larger insulators of higher grade may be used, but the expense runs up exceedingly rapidly with the voltage. Mershon in an article on the limit of power transmission estimates that the cost of insulators of the present types increases with the cube of the voltage. There is perhaps no other branch of engineering where the factor of safety used has been as small as in high-tension power transmission, particularly considering the fact that surges of pressure on the line are sure to appear.

Present practice in this respect is changing, and insulators which a short time ago were rated for high voltages are now marked for lower voltages. It would certainly seem good practice to increase the factor of safety used in work of this nature. As the expense of the insulator increases, it is natural to attempt to use as few of them as possible, and we are naturally led to increasing the length of the spans as far as is practicable. For a long time 40 to 50 poles per mile were regarded as good practice for transmission circuits. Now, however, there is a tendency to a radical change in line work, and lines have been constructed with as few as ten towers per mile. With long span work the poles must be stronger, and, owing to the increased sag, they must be longer, so that steel tower construction is naturally suggested, and has been employed for a few plants. In addition to the greatly increased life of steel, the decreased weight of this construction over wood may be another argument for its use in places where hauling is costly or difficult.

The insulators for high voltages are so large that they are usually of sufficient strength to stand the mechanical strains due to long span work.

The question to be solved by the engineer is how long can the spans be made advantageously, and what stresses are liable to come on the wires. If not properly designed, long span work introduces a new element into the problem which may give rise to a serious source of danger, which does not exist in most lines as they are now constructed; namely, mechanical weakness. Perhaps the greatest source of danger resides in the tensional strain to which the wire is subjected. Strains on the line wire will in general be due to (1) the weight of the wire, (2) the weight of ice forming on the wire, (3) wind pressure, (4) temperature changes.

The wire, under all circumstances, will assume practically the curve of a catenary, which in general, except for excessive spans, can be considered as a parabola, which has a much simpler equation. Consider the external forces acting on a unit length of wire of diameter d surrounded by a cylinder of ice of thickness t.

The weight of gravity acts downward with a force of $W = W_1 \frac{\pi}{4} d^2 + W_2 \pi (td + t^2)$, where W_1 = weight of unit cube of wire and W_2 = weight of unit cube of ice.

Let V = the velocity of the wind, making an angle ϕ with the plane of the wire. Then the wind pressure on the unit length of the wire will be $K V^2 (d + 2t) \sin^2 \phi = P$, where K is a constant. If the wind is horizontal, the direction of the component of wind pressure will also be horizontal, and at right angles to the forces of gravity. Hence the maximum intensity of the forces acting on the unit length of wire (the resultant of these two forces) will be $\sqrt{P^2 + W^2}$, and the wire will assume a plane making an angle Θ with the vertical where $\tan \Theta = \frac{P}{W}$, as shown in the accompanying illustration.

The total force, $\sqrt{P^2 + W^2}$, acting on the unit length of wire, may be expressed as a constant, n, times the weight of the unit length of wire, $W_1 \frac{\pi}{4} d^2$.

Obviously the effect of climatic conditions will be relatively greater for smaller wires than for larger wires, and under similar conditions of sag, and initial intensity of tension, the smaller wire will not be as strong as the larger one. The relative strengths will be determined by the relative values of the coefficient, n, and when this is given we are no longer concerned with the size of wire in determining the strength. The wire can then be regarded as having a certain initial sag, for a given span and temperature, and then the maximum strain which can come on the wire can be estimated by assuming a minimum temperature, and that the unit weight of wire is increased n times, the section remaining the same. Obviously the highest value of n will come when the temperature is lowest, the wire is most heavily coated with ice, the velocity of wind is the highest, and the wind is normal to the line. The pressure of the wind is directly proportional to the diameter of the wire, or if ice coated, to the diameter of the coating of ice. It is also directly proportional to the square of the velocity of the wind. If the wind makes an angle ϕ with the wire, it is assumed to have a pressure $K V^2 \sin^2 \phi \times d$ per unit of length, or a maximum pressure while normal to the wire of $K V^2 d$. The value of K is a matter of some doubt, some authorities stating that the pressure is ½, and others that it is ⅔ of the wind pressure on a flat surface equal to the projected area of the wire. These facts will be discussed more fully in a subsequent article.

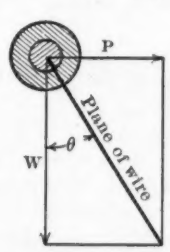


DIAGRAM OF STRESSES ON WIRE.

At 32° F. and at the normal barometric pressure of 29.9 in. of mercury at sea level a velocity of 57.8 miles per hour will give a velocity head pressure of 1 ounce per sq. in. Taking this as a basis, the following table shows the relation between wind pressures, velocities and apparent increase in the actual weight of the wire assuming that the wind is horizontal and normal to the line.

Column 1 gives wind velocity where the coefficient of pressure is 1.00 and column 2 where the coefficient is .62. From the best information obtainable it would appear that pressures on wires and cables will lie between values given by these coefficients. It must be remembered that if lower temperatures are

COPPER.

Miles per hour. Wind velocity where pressure on diam. is due to velocity head times.	Coefficient of	Values of n											
		No. 8.	No. 6	No. 4		No. 2		No. 0		No. 0000		500,000 c.m.	1,000,000 c.m.
1.00	.62	W.C.	W.	W.	C.	W.	C.	W.	C.	W.	C.	C.	C.
40	50.8	1.36	1.24	1.16	1.19	1.10	1.12	1.07	1.09	1.03	1.04	1.02	1.01
50	63.5	1.75	1.53	1.35	1.43	1.23	1.28	1.15	1.20	1.08	1.10	1.05	1.02
60	76.2	2.30	1.93	1.65	1.78	1.44	1.53	1.30	1.37	1.16	1.20	1.09	1.05
70	88.9	3.00	2.47	2.05	2.24	1.73	1.87	1.50	1.63	1.28	1.35	1.16	1.08
80	101.7	3.82	3.12	2.33	2.80	2.10	2.29	1.77	1.95	1.44	1.55	1.27	1.14
90	114.3	4.78	3.87	2.95	3.46	2.54	2.79	2.10	2.34	1.65	1.80	1.40	1.21
100	127.0	5.88	4.72	3.78	4.21	3.05	3.37	2.50	2.81	1.90	2.10	1.57	1.31

ALUMINUM.

Wind velocities for coefficient.		Values of n											
		No. 8.	No. 6		No. 4		No. 2		No. 0		No. 0000	500,000 c.m.	1,000,000 c.m.
1.00	.62	W.	W.	C.	W.	C.	W.	C.	W.	C.	W.	C.	C,
40	50.8	3.20	2.63	2.85	2.17	2.38	1.83	1.92	1.57	1.68	1.32	1.39	1.19	1.10
50	63.5	4.89	3.93	4.31	3.17	3.52	2.59	2.75	2.14	2.36	1.67	1.80	1.41	1.22
60	76.2	6.97	5.67	6.11	4.46	4.95	3.58	3.83	2.91	3.24	2.17	2.38	1.75	1.42
70	88.9	9.43	7.52	8.28	5.98	6.66	4.78	5.14	3.85	4.30	2.82	3.11	2.04	1.70
80	101.7	12.30	9.78	10.78	7.79	8.68	6.20	6.64	4.95	5.57	3.58	3.98	2.74	2.06
90	114.3	15.5	12.35	13.4	9.83	10.97	7.82	8.37	6.24	7.00	4.46	4.97	3.47	2.49
100	127.0	19.2	15.25	16.8	12.12	13.54	9.63	10.32	7.68	8.62	5.48	6.10	4.11	3.00

to be encountered the density of air and air pressures would increase. Wire sizes are in B. & S. gauge, *W* denoting wire, and *C* cable.

With respect to the strains brought on the wires by snow and ice, we can naturally expect the greatest divergence of opinion on the nature of such loads.

The greatest dead weight which will come on a wire in cold climates will usually consist of snow. It is probable, however, that the greatest strain which could come on the wires would consist of a coating of ice while the wind was at a maximum velocity, normal to the wire, since under the later conditions the snow would probably blow off, though the swaying of the wire would tend to crack the ice. There is no common agreement as to the probable thickness of ice.

Assuming a maximum thickness of ½ in. the following tables give data about the relative increase in the constant, *n*, for various velocities of wind, and for various sizes of copper and aluminum wires and cables.

COPPER.

Wind velocities for coefficients of		Values of n						
		No. 8.	No. 4		No. 0		No. 0000	500,000 c.m.
1.0	.62	Wire.	Wire.	Cable.	Wire.	Cable.		
0	0	8.90	4.51	4.62	2.62	2.69	1.94	1.54
30	38.1	10.0	4.91	5.02	2.75	2.84	2.00	1.55
40	50.8	12.0	5.67	5.79	3.01	3.09	2.12	1.60
50	63.5	15.5	7.02	7.14	3.51	3.59	2.35	1.68
60	76.2	20.3	8.95	9.10	4.26	4.37	2.72	1.82
70	88.9	24.3	11.45	11.60	5.25	5.39	3.25	2.12

ALUMINUM.

0	0	27.3	12.65	13.4	6.40	6.62	4.12	2.79
30	38.1	31.3	14.2	14.7	6.98	7.21	4.42	2.90
40	50.8	38.3	17.0	17.5	8.10	8.35	5.00	3.13
50	63.5	50.3	21.9	22.3	10.0	10.3	6.05	3.56
60	76.2	66.7	28.6	29.1	12.9	13.2	7.56	4.23
70	88.9	89.5	37.2	38.0	16.5	16.9	9.58	5.16

The manufacturers of aluminum claim that ice forms with difficulty on aluminum, and far more readily on copper. It is evident, assuming any appreciable thickness of ice, that long-span work is out of the question in cold climates, unless the wires are of considerable size.

It is interesting to contrast the relative stresses in aluminum and copper line wire of equal electrical conductivity.

Let weight of copper wire $= W D^2$ per ft., where D = diameter in inches.

Let weight of equal conductivity aluminum wire be $w d^2$ per ft. $d = 1.25\ D$; $W = 3.33\ w$.

Let P = wind pressure per 1 in. diameter and 1 ft. long.

$$\text{Tension on copper} \propto \sqrt{\overline{W D^2}^2 + \overline{P D^2}^2} = D \cdot \sqrt{W^2 D^2 + P^2}.$$

$$\text{Stress on copper} \propto \sqrt{\frac{W^2 D^2 + P^2}{D}}.$$

$$\text{Stress on aluminum} \propto \sqrt{\left(\frac{1.25}{3.33}\right)^2 W^2 D^2 + P^2}.$$

$$\frac{}{1.25 \times D}.$$

Considering hard-drawn copper, the wires will be relatively equally stressed when

$$\frac{1.25\ \sqrt{W^2 D^2 + P^2}}{\sqrt{.1405\ W^2 D^2 + P^2}} = \frac{60{,}000}{26{,}000}.$$

Solving this gives $P = .467\ W\ D$.

If we use the elastic limits of the wires instead of the tensile strengths, then using 14,000 lb. for aluminum and 32,000 lb. for hard-drawn copper, the equation would be

$$\frac{W^2 D^2 + P}{.1405\ W^2 D^2 + P^2} = \left(\frac{32}{14 \times 1.25}\right)^2 = 3.35.$$

Hence,

$$P^2 = \frac{.529}{2.35}\ W^2 D^2,$$

$$P\ D = W\ D^2 \times .474.$$

To compare the breaking strength of aluminum and of soft-drawn copper of 34,000 lb. ultimate strength, we get similarly:

$$P\ D = W\ D^2 \times 3.02.$$

To sum up, two wires of copper and aluminum having the same electrical conductivity will have the same factors of safety under similar wind and temperature conditions, the spans and total deflections being the same when using ultimate strengths as a criterion, if the wind is such as to produce a deflection ϕ from the vertical and a coefficient n as follows:

	ϕ	n
Soft-drawn copper	72°	3.18
Aluminum	83°	8.1
Hard-drawn copper	25°	1.10
Aluminum	51°	1.59

With the range of wind encountered and the sizes of wire commonly used it is evident that on the *above basis of comparison alone* hard-drawn copper is superior and soft-drawn not so good as aluminum.

Wires should be so strung that under the worst conditions of weather they will not be stressed beyond a certain point. In long-span work we are concerned mainly with the maximum deflection both with regard to the distance of the wires above earth and hence the height of poles, and also the possibility of long wires with too much slack swinging together.

Since the coefficient of expansion of aluminum is .0000128, as against .0000096 for copper, and the modulus of elasticity 9,000,000 for aluminum, against 16,000,000 for hard-drawn copper, and the elastic limit is 14,000 for aluminum, against 32,000 for copper, evidently aluminum is at a considerable disadvantage over copper, since the effects of expansion are much more severe, and though the modulus of elasticity is smaller, being 56 per cent of that of copper, still the elastic limit is less than 44 per cent of that of copper. Hence the wire is capable of only 78 per cent of the elongation or contraction of copper and must be strung in general with much more slack. There are, however, other considerations besides the extension of the wires, namely, the effects of strains on the poles and insulators. The downward strain due to the dead weight of the wires is much less for aluminum than for copper. The side strain on pole lines and pins, due to wind pressure, is 25 per cent more severe with aluminum than with the equivalent copper wire, due to its larger area. The same remarks

apply to the strains on corner poles due to wind pressure. However, the strain on corner poles due to tension in the wires, without consideration of wind, is greater in copper than in aluminum lines.

In the event of one wire parting, copper wire will throw greater strains on the cross arms than aluminum. In general the advantages of line construction appear to be with copper wire, and increase the smaller the size of the wire used. With larger sizes the advantage is less marked.

The most economic span to use would be the span in which the cost of insulators and towers is a minimum provided the voltage and size of wire are settled. The higher the tower the longer could be the span. It is strange that engineering practice should have kept so long to 40 to 50 poles per mile, and not have endeavored to find more economic pole lines; certainly a jump from 100 to 500 ft. in spans, which latter is found in some recent constructions, seems startling at first glance. If we suppose the size of wire and voltage given, and the insulators determined, then we may express the cost of one pole and insulators by an equation:

$$A' + B'H + C'H^2 + D'y + E'y\,H + G'y\,H^2 \qquad (a)$$

where H = height of pole; y = length of ½ span. The other numbers are constants.

If h = fixed distance between ground and lowest part of wire at greatest sag, X, then $H = E + h + X$, and we may write (a), $A + B\,X + C\,X^2 + D\,y + F\,y\,X + G\,y\,X^2$, and the cost per unit length of line

$$= ½\left(\frac{A}{y} + \frac{B\,X}{y} + \frac{C\,X^2}{y} + D + F\,X + G\,X^2\right) \qquad (b)$$

The most economic pole line requires this to be a minimum and hence by substituting the value of X in terms of y in (b), differentiating with respect to y, equating to zero, and solving for y, we should get the desired span. It is obvious that this span would in general be shorter for small wires than for large wires, all depending on the coefficient, n.

It is a simple matter to find an equation between X and y, but as it is a cubic, it will be easier to assume different spans and calculate (b) and find when it is a minimum, than to try to obtain general mathematical expressions for it. The use of the coefficient n enables a very simple equation to be obtained between X, y and n, where X is the maximum sag when hot, and n is for the lowest temperature and worst conditions of wind and ice. All that need be known is the allowable stress and the maximum temperature variation. The following equations are approximately true, and are sufficiently accurate for almost any practical case.

$$x = \frac{y^2\,nW}{2\,T}, \qquad (1)$$

where x = central deflection, ft.,
y = length of half span, ft.,
n = coefficient as specified,
W = weight of the material of the wire 1 in. square and 1 ft. long, lbs.,
T = tension in wire, lbs. per sq. in.

Obviously knowing n we may disregard the size of the wire, and treat it for unit section.

Let l = length of stretched wire in ½ span, then approximately,

$$l = y\left[1 + ⅔\left(\frac{x}{y}\right)^2\right] \qquad (2)$$

This wire, however, though of length l when stretched, will be shorter when the stress is removed by a quantity

$$\frac{T\,l}{E} = a\,l, \qquad (3)$$

where E = modulus of elasticity of the metal. Having fixed the stress of the wire under the worst conditions, the only other problems of importance are determining the proper tension when stringing it, and also the maximum sag. This latter will usually occur when the wire is hottest.

The maximum vertical deflection is generally desired, and this will usually occur with no wind when $n = 1$

Let F = maximum degrees rise in temperature.
K = coefficient of linear expansion.
L_m = length of wire at maximum temperature when unstressed.
L_o = length of wire at minimum temperature when unstressed.
$L_m = (1 + K\,F)\,L_o$.
X = maximum deflection.
x = minimum deflection.
l = stressed length with minimum deflection.

Then T, y and n being fixed, equation (1) gives x and equation (2) gives

$$l = y\left[1 + ⅔\left(\frac{x}{y}\right)\right] = y\left[1 + ⅙\left(\frac{y\,nW}{T}\right)^2\right] \qquad (4)$$

$$L_o = l\,(1-a) = l\left(1-\frac{T}{E}\right) = y\left(1-\frac{T}{E}\right)\left[1+⅙\left(\frac{y\,nW}{T}\right)^2\right] \qquad (5)$$

$$L_m = (1 + K\,F)\left(1-\frac{T}{E}\right)\ y\left[1+⅙\left(\frac{y\,nW}{T}\right)^2\right] \qquad (6)$$

$$= c\,y + d\,n^2\,y^5,\ c \text{ and } d \text{ being constants.}$$

Let l_m = stressed length under greatest sag, and let t = corresponding stress.

$$l_m = L_m\left(1 + \frac{t}{E}\right) \qquad (7) \qquad X = \frac{y^2\,W}{2\,t} \qquad (8)$$

$$l_m = y\left[1 + ⅔\left(\frac{X}{y}\right)^2\right] = L_m\left(1 + \frac{t}{E}\right) \qquad (9)$$

$$= L_m\left(1 + \frac{y^2\,W}{2\,X\,E}\right)$$

Hence, $$X\,y + \frac{2\,X^3}{3\,y} = X\,L_m + \frac{y^2\,W}{2\,E}\,L_m.$$

$$X^3 + X\left[\frac{3\,y^2}{2} - \frac{3\,c\,y^2}{2} - \frac{3}{2}\,d\,n^2y^4\right] = \frac{3\,W\,c}{4\,E}\,y^4 + \frac{3}{4}\,\frac{W\,d}{E}\,n^2y^6$$

or $$X^3 + [e\,y^2 + f\,n^2y^4]\,X = g\,y^4 + h\,n^2y^6 \qquad (10)$$

where e, f, g and h are constants.

Assuming fixed temperature limits, etc., this equation contains only the variables, X, n and y, and when the span and n are known, X may be easily determined. Equation (10) may be written

$$X^3 + \left[3{,}750\left(\frac{T}{E} - K\,F\right)Y^2 - 1.565\left(\frac{1{,}000\,W}{T}\right)^2 n^2\,Y^4\right]X = 4.7\,\frac{10^6\,W}{E}\,Y^4 + 1.96\,\frac{W^3\times 10^9}{T^2\,E}\,n^3Y^6 \qquad (11)$$

where Y = length of span in hundred feet.

This equation is obtained by making a few approximations which are entirely allowable. The last term of the equation, for most cases in practice, is negligible, unless Y or n are excessively great, and may be disregarded in general without involving any practical error. The equation may then be treated as a quadratic in Y^2 and solved. The result is as follows:

$$Y^2 = \frac{m\,X}{10^{-6}\left(\frac{9.4\,W}{E} + 3.13\,\frac{W^2}{T^2}\,n^2X\right)\left[1+\sqrt{1+10^{-6}\left(\frac{18.8\,W\,X}{T^2\,m^2} + \frac{6.26\,W^2n^2\,X^2}{E\,m^2}\right)}\right]} \qquad (12)$$

where $$m = 3{,}750\left(\frac{T}{E} - K\,F\right)$$

Equations (11) and (12) are general, and by the substitution of the numerical values of T, E, K, F and W, can be much simplified. Taking the value of n from the tables already given, and assuming either X or Y—usually the latter, the value of the other unknown may be easily found.

The following assumptions will be made in regard to hard-drawn copper and aluminum:

	Hard-drawn copper.	Aluminum.
Elastic limit lbs. per sq. in.....	32,000	14,000
Modulus of elasticity = E.....	16,000,000	9,000,000
Wt. per sq. in., 1 ft. long = W....	3.85	1.155
Linear coefficient of expansion = K.	.000,0096	.000,0128
Total temperature variation in degrees F = F.....	150	150

If we assume $T = 70$ per cent of the elastic limit, then, for copper, equation (11) becomes

$$X^3 - (0.15\,Y^2 + .0460\,n^2Y^4)\,X = 1.128\,Y^4 + 13.9\,n^2Y^3 \times 10^{-6}.$$

If $Y = 5$, this becomes

$$X^3 - (3.75 + 28.5\,n^2)\,X = 705 + .217\,n^2.$$

If $n = 2$, this becomes

$$X^3 - 110.2\,X = 706.$$

Solving, $X = 12.8$.

For aluminum equation (11) becomes

$$X^3 - X\,(3.11\,Y^2 + .0217\,n^2Y^4) = .603\,Y^4 + 3.47\,n^2Y^3\,10^{-6}.$$

If $Y = 5$, this becomes

$$X^3 - (77.8 + 13.56\,n^2)\,X = 375 + .0542\,n^2.$$

If $n = 5$, this becomes

$$X^3 - 417\,X = 376.$$

Solving, $X = 20.8$.

If we assume T to be the elastic limit, and that the wire will simply stretch and relieve the tension, should this limit be passed, then the following general equations will hold true.

For hard-drawn copper:

$$X^3 + (2.10\,Y^2 - .0227\,n^2Y^4)\,X = 1.132\,Y^4 + 3.49 \times 10^{-6}\,n^2Y^3$$

and

$$Y^2 = \frac{2.10\,X}{2.264 + .0453\,n^2X}\left[1 + \sqrt{1 + 1.027\,X + .0205\,n^2X^2}\right]$$

and for aluminum,

$$X^3 - (1.366\,Y^2 + .01064\,n^2Y^4)\,X = .603\,Y^4 + .874\,n^2Y^3\,10^{-6}$$

and

$$Y^2 = \frac{1.366\,X}{1.206 + .02128\,n^2X}\left[\sqrt{1 + 1.3\,X + .0228\,n^2X^2} - 1\right]$$

In general, even for very long spans, the increased length of wire will hardly be appreciable. It has been urged against long-span work that it necessitates steel towers to withstand the strains and that steel towers if the insulator breaks down will allow the line to come in contact with the ground. Moreover, if a long span breaks, it will be far more difficult to repair than in the case of a short span.

The transmission line is often the most expensive part of the plant, hence it will certainly pay to devote considerable time and trouble to studying transmission economics. The conditions of the case should be given careful consideration since comparatively few designs of structures will answer for very extended systems where thousands of dollars may be saved by careful engineering.

The problems of the future of electricity are more and more closely linked with the possibilities of long-distance transmission. It is obvious that it is not economical, as far as the poles are concerned, to use the same spans for small and large wires, also climates where snow and ice occur require shorter spans than milder climates, since sleet will form on high-potential lines, to a certain extent, in spite of the static effect, and since moreover when the lines are dead, there will be no such effect to keep the ice away.

The density of the air in high localities is far less than near the sea level, thus causing far smaller strains for the same velocity of wind.

If the mechanical strength of the insulators is liable to be exceeded, this fact may modify the length of span otherwise desirable. Present prices seem to point to excessive costs for very high voltage insulators, which long-span work will become a potent factor in saving.

In exceptional cases steel cables are used in very long spans, on account of their very high tensile strength. According to theory, they would have a comparatively limited current carrying capacity for alternating current, on account of their inductive effect.

In designing long spans due attention should be given to special local conditions, particularly with reference to possible wind pressures. The wind will not always be horizontal, hence if it is partly downward it will of course increase the coefficient, n. The liability of sudden gusts must also be considered, as they will be in the nature of a live load, and will cause greater strains than the corresponding dead load, due to an equal velocity of air.

The highest wind velocities on record, with the exception of tornadoes, have not exceeded 120 miles per hour. Unless conditions are unfavorable it is probable that in most parts of California 80 miles per hour would be a safe estimate of maximum actual velocity, and would be higher than would be experienced in many other parts of the country.

Experience with very long spans is rather limited as yet, but from what can be gathered from present experimental spans 1,000 ft. long, contrary to what might be expected, there is no tendency for the wires to swing together if spaced 6 ft. apart, and in fact the wires will deflect in unison.

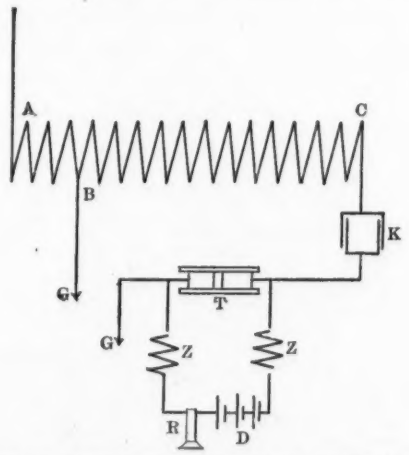
Carborundum as a Wireless Telegraph Receiver.

By H. J. Round.

The attention of the writer was lately drawn to the fact that carborundum, the compound of carbon and silicon, is a very superior substitute for oxidized metals or carbon heretofore used in imperfect contact receivers for Hertzian wave telegraphy. To whom its use was originally due could not be ascertained.

All imperfect contact receivers except carborundum and perhaps the liquid barreter are variable in their action, liable to change of adjustment with vibration or atmospheric electricity, so much so that they are almost useless except for testing purposes. Carborundum is a crystalline substance of extreme hardness and can be used for grinding the hardest of precious stones.

To determine the action of carborundum as a wireless telegraph



CONNECTIONS TO CARBORUNDUM WIRELESS TELEGRAPH RECEIVER.

receiver a bare copper wire was bound around each end of a small piece of the material so as to enable a connection to be made from the antennae to ground on a receiving circuit. The antennae and ground connections were then made and a telephone receiver in series with four dry cells also connected on to the two wires. Very clear and constant signals could be heard from the transmitting station, but the sensitiveness was small compared with a barreter or magnetic detector. The addition of inductance or capacity in series with the antennae circuit seemed not to improve matters appreciably, although with the magnetic detector the best signals were obtained when a large amount of inductance was in series with the circuit. Two choke coils, each consisting of 150 ft. of No. 36 wire wound in one layer on a paper tube, were then placed between the connections to the car-

borundum and the telephone and battery of the local circuit, the result being a distinct improvement in the signals.

At this point it was noticed that variation of pressure at the places of contact of the copper and carborundum had a distinct action on the signals, and also too much pressure produced the well known roaring sound obtained with other forms of microphonic contact. Some of the material was crushed to a fairly fine powder and placed between clean copper plugs in a glass tube. By means of a screw the pressure could be varied to any extent. To some extent the voltage in the circuit could be altered as the pressure varied but very little attention was paid to this point.

About five dry cells were used with the powdered material, a potentiometer being unnecessary.

With several different wave lengths the arrangement shown in the diagram gave by far the best results and the sensitiveness then approached that of the barreter and the magnetic detector. In the diagram, *A B G* is the aerial ground circuit acting inductively on the circuit. *G B C K G*. *A C* is an inductance consisting of a hundred turns of No. 16 cotton-covered wire wound closely in one layer on a 1-ft. square frame. The length from *A* to *B*, which latter point is grounded, varies with the wave length. The length from *B* to *C* depends on the capacity of the condenser *K* and the wave length. *T* is the carborundum tube, *ZZ* the choke coils, and *R* and *D* the telephone and battery.

The best results were obtained when the inductance of *B C* was large and the capacity of the condenser *K* was small. With the carbon microphone, as the inductance of *B C* was increased and the capacity of *K* decreased the voltage in the local circuit had to be lowered to get the strongest signals. No attempt however was made to observe this effect with carborundum.

The most striking point about the carborundum receiver is its absolute constancy, jarring or vibration not interfering with its action or causing troublesome noises. The crystals no doubt give very sharp edges along which contact is made and the constancy is due to the extreme hardness of the substance.

Predetermination of the Length of Armature Conductors.

By A. I. M. Winetraub.

FOR predetermining the pressure drop and the armature copper losses of a generator or motor, it is necessary to find the total resistance of the armature conductors.

S. P. Thompson, in "Design of Dynamos," gives the following expression for the total resistance of the armature conductors considered all in series and irrespective of their grouping:—

$$r = \left[.000008 \left\{ 1 + .004\ (t\text{-}15) \right\} \right] \frac{l}{s}$$

where l = total length of armature conductors in feet, and s is the cross section of the conductor in square inches. It is to be noted, however, that l is not readily predetermined for a machine in the course of design, and this is especially true if the pitch or spacing of the winding reaches over a considerable portion of the armature.

Let X be the true length of the portion of the conductor extending from the end of the armature core to the point on the commutator whereto the conductor is being led and soldered.

This X varies, of course, with the pitch of winding, diameter of the commutator, diameter of armature and with the distance from the commutator to the armature.

In the following a method is described whereby the value of X can be obtained.

If l = total length of all conductors in series

n = number of armature slots

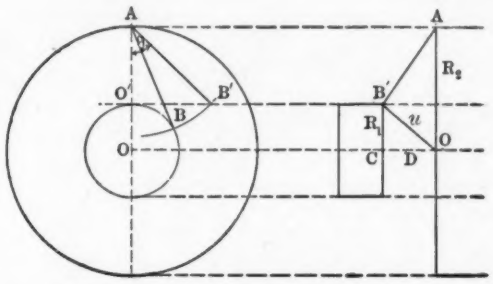
N = conductors per slot and $L = \frac{l}{n N}$ = length of one conductor, then $l = L\,n\,N$

Now, $L = a + b + x$ ft., where a = length of conductor from end to end of armature iron core, b = half the length of the cord subtending the armature pitch arc in back of armature (which can be accurately obtained by another method) and x = the length of conductor from armature slot to the commutator point to which the conductor is being led and soldered.

Let Figs. 1 and 2 represent an armature and let R_1 = radius of the circle over the soldering ends of the commutator and R_2 = radius of circle over center of armature slots.

Let *A B* represent the apparent value of the portion X.

If the line *A B* be revolved in Fig. 1 about *O'A* and into the



FIGS. 1 AND 2.—DIAGRAMMATIC VIEWS OF ARMATURE WINDING.

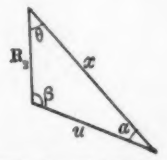


FIG. 3.—DIAGRAM OF DIMENSIONS.

vertical plane, the actual angle Θ made by the true length X with the radius of the armature *O A* could be laid out and measured graphically.

We can now imagine a right-angle triangle, with the radius R_1 of the commutator as base, the distance D from the end of the commutator to the beginning of the armature core on the axis of the shaft as height, and u as hypothenuse.

Then we have $u = \sqrt{R_1^2 + D^2}$, u being the actual distance from commutator joint to the center of the end of the armature core.

Now we can imagine another triangle, such that one side is the radius of the armature core, another side is u and the third side is the actual length wanted, X.

In this new triangle, Fig. 3 (see also Fig. 2), we have $u = \sqrt{R_1^2 + D^2}$; R_2 is known and Θ is the true angle made by the true length with the radius of the armature core, and which was measured graphically.

Now X can be obtained:

$$\frac{u}{\sin \Theta} = \frac{X}{\sin \beta} = \frac{R_2}{\sin \alpha} \qquad \therefore X = \frac{R_2 \sin \beta}{\sin \alpha}$$

but $\sin \beta = \sin\ (\alpha + \Theta)$ $\therefore X = \dfrac{R_2 \sin\ (\alpha + \Theta)}{\sin \alpha}$

or $X = R_2\ (\cos \Theta + \sin \Theta \operatorname{cotang} \alpha)$

but $\sin \alpha = \dfrac{R_2 \sin \Theta}{u}$ and since $\operatorname{cotang} \alpha = \sqrt{\dfrac{1}{\sin^2 \alpha} - 1}$

$$\operatorname{cotang} \alpha = \frac{\sqrt{u^2 - R_2^2 \sin^2 \Theta}}{R_2 \sin \Theta}$$

$$\therefore X = R_2 \cos \Theta + \sqrt{u^2 - R_2^2 \sin^2 \Theta}$$

or $X = R_2 \cos \Theta + \sqrt{R_1^2 + D^2 - R_2^2 \sin^2 \Theta}$

which gives X in terms of known quantities.

Now $l = L\,n\,N = (a + b + x)\,n\,N$

and

$$r = \left[.000008 \left\{ 1 + .004\ (t - 15) \right\} \right] \frac{(a + b + x)\,n\,N}{s}$$

which is the total resistance of the armature conductors, considered all in series and irrespective of their grouping.

Tests of Electrically-Driven Planers.

By Geo. H. Schaeffer and Chas. E. Butz.

The following tests on electrically-driven planers were made at the Bethlehem Steel Works at South Bethlehem, Pa., the object of the tests being to get the variation of power required at different points in the motion of the table. The machines were entirely new, as were also the motors and the gearing. Before beginning tests the meters were calibrated. All readings were taken several times as a check to accuracy.

Test of 36-in. x 36-in. x 14-ft. Planer.

Following are the data of a test on a 36-in. x 36-in. x 14-ft. planer built by the Pond Machine Tool Company, and shown in Fig. 1. The motor, which is on top and connected to the planer by a Morse silent chain, is a 10-hp shunt motor running at 650 r.p.m. at 220 volts. The weight of planer table is 10,550 lbs. The work consisted of a cut on nickel steel, the depth being 7/16 in. and the length of cut, 21 11/16 in. The time of the forward travel of the table was 5.43 seconds, and of return travel, 2.94 seconds. The temperature of the motor field coils after five hours' run was 45°; armature conductors (center), 53°; commutator, 60°; room, 20½°; maximum rise, 39½°.

Table I gives the voltage and current readings for the different

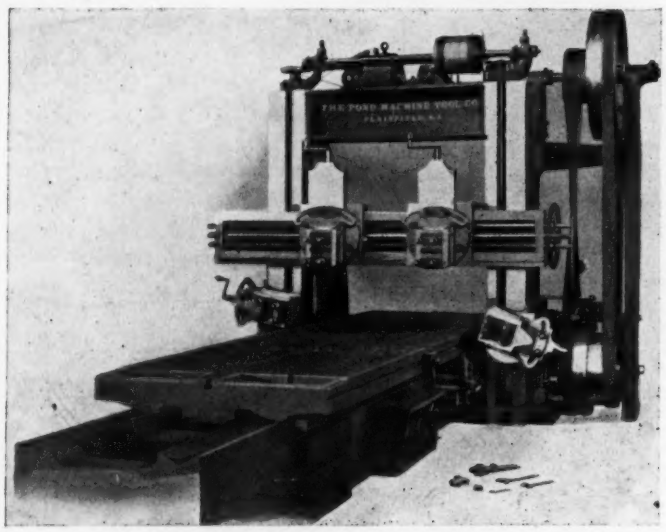


Fig. 1.—Electrically-Driven Planer.

positions of table while the machine was in actual working condition.

Table I.

Table movement.	Volts line.	Amps. line.	Amp. fld.	Motor speed.
Forward to cut.....	200	34.	1.43	612
Forward cutting	198	45.6	1.42	612
Reverse	199	88.0	1.42	612
Quick return	200	34.0	1.43	612
Reverse to cut	200	42.0	1.43	612
Table disconnected	216	8.5	1.45	620

In calculating the no-load loss of the motor, the chain could not readily be disconnected, so the motor and gearing were considered as one. The stray power amounted to 1,642 watts.

Table II gives the results directly in watts. The no-load and R^2I losses were determined so that the net watts used by the machine alone could be calculated. The table gives the net watts used to overcome losses in the motor gearing, friction of machine and useful work in moving the table and in cutting.

Table II.—Watts.

Table movement.	Total power applied to motor	Loss in motor and gearing.	Loss in machine.	Power used in cutting.	Time of travel of table in seconds.
Forward to cut.....6800		2650	4150	....	..
Forward cutting ...9030		3400	4140	1490	5.7
Reverse 17515		7075	10440	....	.3
Quick return 6800		2650	4150	....	2.4
Reverse to cut.....8400		3140	5260	....	.3

By calculation it was found that 1,490 watts were used to cut the metal, out of a total of 9,030 watts supplied. This gives 16.5 per cent of useful power, the rest being lost in motor, gearing and friction. One tool was used; a second one would have required approximately 16.5 per cent more power. It is evident that the use of more than one tool saves not only in labor, but also in power.

The total time for a complete cycle was 8.7 seconds, and the actual cutting took place during 4.86 seconds. Thus 56 per cent of the time of whole stroke was employed in cutting. The overall efficiency of the machine was thus 16.5 × .56 or 9.2 per cent.

The loss in the machine was doubled through a tight bearing on

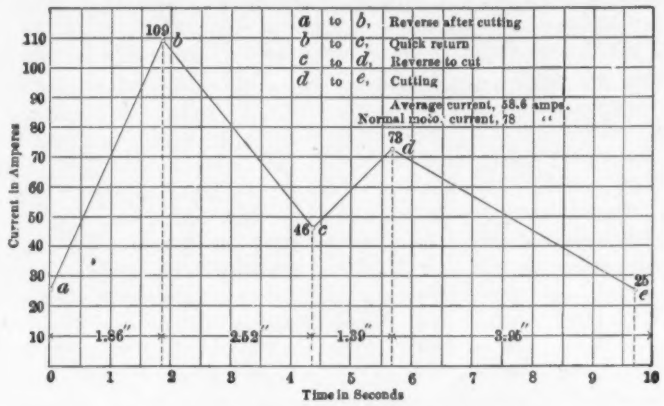


Fig. 2.—Curve of Current Consumption.

the housing. The size of the motor for normal conditions is ample, but due to one tight bearing the motor had an overload of 7 per cent, which indicates the waste of power that may occur through a poor bearing. This, however, did not affect the object of the experiment, which was to get the net watts used to cut the metal.

The current in the ammeter kept time with the motion of the table. The time of rising and falling of the needle was carefully determined with a special stop watch, and the results are plotted in the curve of Fig. 2.

Test of a 48-in. x 48-in. x 12-ft. Planer.

This planer, built also by the Pond Machine Tool Company and similar in appearance to that shown in Fig. 1, was provided with four heads for cutting. The weight of the table was 11,650 lbs. The machine was equipped with a compound motor rated at 20 hp at 220 volts and 975 r.p.m. The motor was placed on top and connected to the planer by a Morse silent chain. The machine was in perfect condition.

The metal under cut was nickel steel. The depth of cut was 5/16 in.; length of stroke, 4½ ft.; cutting speed, 28 ft. per minute. The time for the table to move forward was 5.64 seconds; to return, 3.36 seconds, and .36 seconds for each reverse, making the total time for a complete cycle 9.72 seconds. One tool was used. The temperatures of the motor at the end of a two-hour run were as follows: Field coils, 42°; armature conductors (center), 47°; commutator, 60°; room, 20½° maximum rise, 26½°.

Table III gives the voltage and current values for the different positions of the table while in actual working condition:

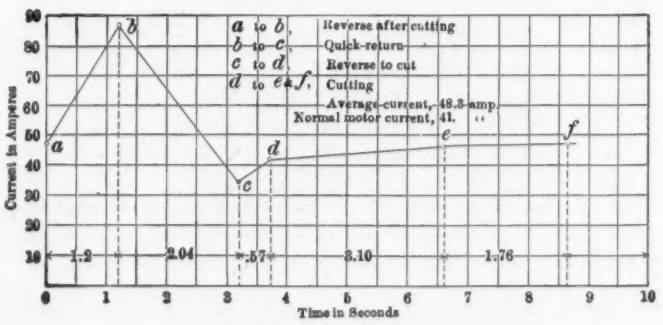


Fig. 3.—Curve of Current Consumption.

Table III.

Table movement.	Volts line.	Amp. line.	Amp. fld.	Motor speed.
Forward to cut...	210	22.5	1.30	900
Forward cutting..	210	25.2	1.30	900
Reverse	206	109.2	1.28	900
Quick return	206.3	67.2	1.28	900
Reverse to cut...	208	71.2	1.29	900
Motor and gearing only, table disconnected.....	212	15	1.31	1020

The friction and windage were taken with the gearing running light, as was also the stray power of the motor. These losses, together with the I^2R losses, were calculated. Table IV gives the power in watts. By subtracting the gearing and motor losses we obtain the net power used by the machine itself, and by further calculating the difference between power taken in running with and without cutting, we obtain the actual power used to remove the metal. The stray power amounted to 2,700 watts.

TABLE IV.—WATTS.

Table movement.	Total power supplied to motor.	Loss in motor and gearing.	Loss in machine.	Watts used to cut (net).	Time.
Forward to cut.....	4790	3045	1745	....	5.64
Forward cutting	5360	3062	1750	548	....
Reverse	22600	4710	17890	....	.36
Quick return	13950	3620	10330	....	3.36
Reverse to cut.....	14780	3800	10980	....	.36

From the Table IV it is evident that only 548 watts out of 5,360, or 10.2 per cent were useful in removing metal. To add another working tool would approximately increase the input only 10 per cent. It is also evident that on the reverse the current is approximately four times the current while cutting; this, however, is only instantaneous and only occurs twice in about 10 seconds and is not taken intc account in calculating the size of motor to use on the planer.

Cutting took place 58 per cent of the time of a complete cycle, giving an overall efficiency of .58x10.2, or 5.67 per cent. To add another tool would take approximately 10 per cent more power and the efficiency would increase as more tools were used. The time of rising and falling of the ammeter needle is plotted in Fig. 3.

The Spokane and Inland Railway.

The new single-phase railway projected to run between Spokane, Wash., and several neighboring cities is now practically finished. This road embodies a number of novel features in electric railway work. The railway was originally incorporated under the name of the Spokane Interurban System with a capital of $3,500,000, the incorporators being well known local capitalists. The principal terminal of the road is Spokane, from which the line runs south through Waverly, Rosalia, Thornton and Colfax, which is the southern terminus at present, although the road has been surveyed and will be eventually extended to Penawawa, Wash., or Lewiston, Idaho. A branch leaves the main road approximately midway between Spokane and Colfax, and extends to Palouse City. The Y-connected system between Spokane, Colfax and Palouse City is about 106 miles in length. The roadway and overhead construction has already been completed.

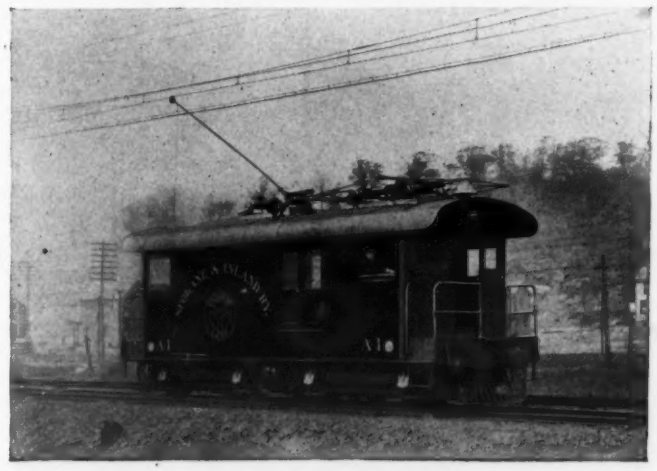


FIG. 1.—VIEW OF LOCOMOTIVE WITH DIRECT-CURRENT TROLLEY IN USE.

In addition to its railway business the company proposes to transmit and distribute electric energy for lighting and power both in the city of Spokane and in the towns through which its lines pass. The country traversed produces large quantities of wheat and fruit and is not provided with any railroad transportation. This insures a large freight business for the new road, as the long wagon haul to the steam railroads will be avoided. For this reason the electric road is receiving the hearty support of the farming interests along its route.

There are three classes of service to be maintained—passenger, mail and express and carload freight; and after a careful consideration of the various systems had been made, the Westinghouse single-phase, alternating-current system was adopted as being economical in first cost, as well as in operating expense, besides permitting the use of locomotives for a system of heavy traction. The cars of the Spokane & Inland enter Spokane over the tracks of the Spokane Traction Company, which operates a 600-volt direct-current system, and this requires the use of both direct and alternating current on the interurban cars.

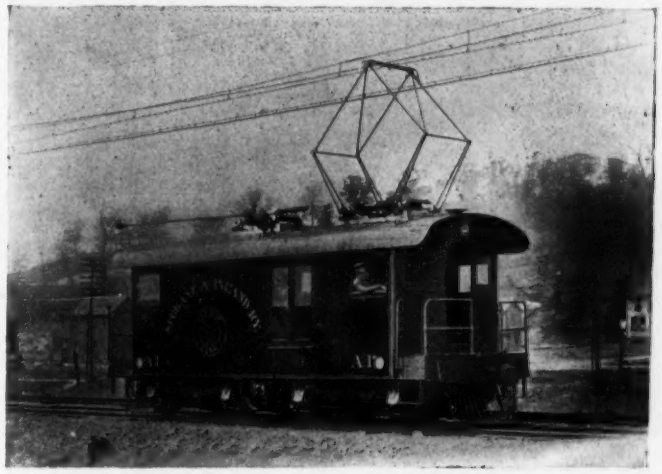


FIG. 2.—PANTAGRAPH TROLLEY FOR ALTERNATING CURRENT.

Energy purchased from the Washington Water Power Company is used for the operation of this road, delivered as 4,000-volt, three-phase current of 60 cycles to a frequency-changing station about 10 miles south of Spokane. This station contains four motor-generator or frequency-changing sets, each of a normal rating of 1,000 kw, consisting of a 1,000-hp, 60-cycle, three-phase, 4,000-volt induction motor; a 1,000-kw, 25-cycle, 2,200-volt, single-phase alternator of the revolving field type, and a 750-hp, 550-volt, direct-current generator which is to float on a storage battery, acting alternately as a motor and as a generator. These three machines are mounted upon a single bed-plate and provided with ample bearings. There are three exciter sets for the alternators, each consisting of a 75-hp, three-phase, 4,000-volt induction motor and a 50-kw, direct-current generator. A 20-panel switchboard, electrically operated oil circuit breakers, and lightning protective apparatus complete the equipment of the frequency changing station.

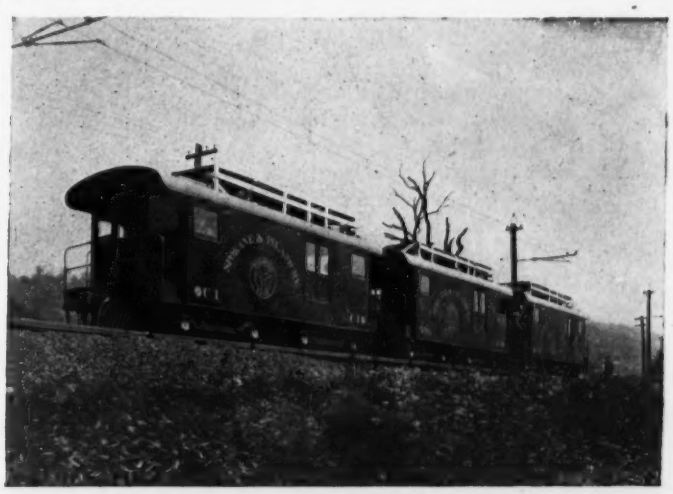


FIG. 3.—THREE ELECTRIC LOCOMOTIVES.

The 2,200-volt, 25-cycle current is stepped up to 45,000 volts by means of four 1,250-kw, oil-insulated, water-cooled transform

ers, and at this pressure is transmitted to 15 static transformer sub-stations. Each sub-station is equipped with two 375-kw transformers of the oil-insulated, self-cooling type which step down the current from 45,000 volts to 6,600 volts, which is the trolley line voltage. The cars and locomotives operate under three different potentials; 6,600 volts alternating current in the country, 700 volts alternating current in the small towns, and 600 volts direct current in the city of Spokane.

The trolley line is of the Westinghouse standard catenary construction with a No. 000 wire carrying 6,600-volt alternating-current. The high tension transmission lines are No. 2 copper wires. The electrical equipment of both the passenger and the express cars is identical and consists of four 100-hp, alternating-current railway motors per car, which will maintain a schedule speed of from 35 to 40 m.p.h. The locomotives are equipped with the same type of motors, but the latter are each of 150 hp capacity. Both the motor cars and the locomotives are operated on the Westinghouse multiple-unit control system.

These locomotives are designed to handle a general carload freight business and are capable of hauling seven standard freight cars fully loaded at about 30 m. p. h. on a level track. They operate on the 6,600-volt and 700-volt alternating-current lines, and on the 600-volt direct-current line. Both pantagraph and wheel trolleys are used, as shown in the accompanying illustrations, Figs. 1, 2 and 3, the pantagraph trolley being for operation on the 6,600-volt circuit and the wheel trolley for the 700-volt alternating and the 600-volt direct-current circuits. The cab of the locomotive serves to enclose the auxiliary apparatus and is constructed entirely of steel. Its total weight is 49 tons and its length over bumpers is 29 ft. It has two swivel trucks with 38-in. driving wheels, and two motors are mounted on each truck and are geared to the axles. Both straight and automatic air brakes are used, the compressed air for which is supplied by two Westinghouse Air Brake Company compressors, each driven by a 5-hp Westinghouse single-phase motor.

The motors are arranged in two groups, each group consisting of two motors connected permanently in series; so that for the purpose of control these groups may be considered as single units in a two-motor equipment. Two auto-transformers are used on the locomotives, and an automatic overload and no-voltage circuit-breaker is placed between the trolley and the transformers, which operates on either overload or no-voltage by breaking the current supply to the control magnets, thus automatically opening all the switches. This circuit breaker must always be closed by hand and it will not stay closed unless the trolley is up and current is on the line.

When the circuit-breaker is thrown in the circuit is completed through the auto-transformers to ground. A commutating switch is automatically shifted to the alternating-current position, and the small transformer furnishing current to the control system is cut into circuit, leaving the locomotive ready to start.

The unit switches are essentially similar to those used on direct-current systems. The control magnets are of the alternating-current type wound for 200 volts and operate on about 80 volts direct current, but in both cases will operate down to about one-half voltage. These magnets serve to admit air under heavy pressure to the cylinders which operate the unit switches. These switches are assembled into a compact unit known as a switch group and the group is protected by an iron case in which it is mounted from the severe exposure to which a locomotive or a street car equipment is subject. Interlock contact blocks are provided which make it impossible for a switch to close or remain closed unless all the other switches operate according to their predetermined cycle. This assures the proper order of switch operation.

The alternating current for the operation of the magnets by the master controller is obtained from the secondary of a small transformer which is connected to the 500-volt point of the main auto-transformer. When operating on direct current a resistance is placed in series with this auxiliary transformer across the 600-volt mains, and direct current is taken from a suitable tap on this resistance. This dispenses with the use of a storage battery for direct-current operation.

The only mechanical operation in going from alternating current to direct current is to change the trolleys; the control is changed automatically by the commutating switch, which is a small pneumatically operated drum for shifting the control circuits. This drum is operated by a magnet connected directly to a 200-volt tap on the main auto-transformer and has no direct-current connection. The switch has one position for direct-current operation and another for alternating-current operation, and it cannot be thrown to the alternating-curret position unless alternating current is flowing through the magnet coil. If it should remain in the direct-current position no harm would be done. The reversing switch is similar to the commutating switch in its operation but is furnished with two magnets and air cylinders, one for each position.

The preliminary order on this contract specified 15 passenger cars, 6 express cars and 6 locomotives, and the rolling stock is in general exemplified in the illustrations herewith shown.

Central Station Performance at San Antonio, Tex.

The central station of the San Antonio Gas & Electric Company, which also supplies the street railway, is located near the center of the city on the banks of the San Antonio River. The station, originally, had all its machinery operated from a long line shaft. It has gradually eliminated the line shaft so that there is a shaft in one end only, large direct-connected units taking most of the load. Although the station is on the river, river water is not needed for condensing water because the company has an artesian well which, by its natural flow, supplied enough water, except on the peak of the load, when a centrifugal pump is brought into action to furnish additional water. This natural flow of condensing water, of course, reduces pumping expenses considerably. Texas crude oil is burned for fuel. The equipment consists of water tube boilers, and two very large new Stirling boilers have just been installed. These boilers are each of 612 rated horse-power and are 24 ft. 6 ins. high to the flange on top of the drum.

OIL CONSUMPTION AND LOAD FACTOR.

Very complete records are kept, as is the case in all of the American Light & Traction Company's plants, of which this is one. A typical fuel performance for 24 hours is as follows, which is taken from the load sheet of May 17, 1906. The average performance was 2,400 watt-hours per gallon of oil for the entire 24 hours. The influence of the load on fuel economy is well brought out by subdividing the day, as is the company's custom in keeping its records. The following table shows the watt-hours per gallon of oil for three periods of the day: 12 m. to 8 a. m., 1,900; 8 a. m. to 4 p. m., 2,355; 4 a. m. to 12 m, 2,650 watt-hours. A gallon of oil weighs 7.7 lbs. and contains 146,762 British thermal units.

DISTRIBUTING SYSTEM.

Most of the stationary motors in the city are run on a 500-volt direct-current circuit. The lighting distribution is by a single-phase circuit from three-phase generators. Single-phase circuits are run out from the switchboard, no three-phase circuits being run on the street. Single-phase motors of not over 1-hp are allowed on the lighting lines. This custom of keeping the lighting and power service separate is one which is very commonly followed in American Light & Traction Company properties, the general policy being to keep the power fluctuations from affecting the lighting service as far as possible. Only two sizes of transformer are used and carried in stock; namely, 15-kw and 5-kw. Transformer primaries are fused for double the maximum load. Enclosed fuses are now used on account of their greater reliability. In the downtown district, secondary circuits fed from different transformers are tied together with D. & W. enclosed fuses of one-third the capacity of the transformers they connect, thus permitting transformers to help each other and at the same time providing for the immediate cutting out of a secondary section upon which there is a short circuit either within or without the transformer. The foregoing figures and data are furnished through the courtesy of Mr. George H .Cushman, superintendent of the company.

Recent Electrochemical Developments.

RESISTANCE FURNACES.

The only electric furnace process which has been introduced into practice on a commercial scale for the production of high-grade zinc is that of de Laval in Sweden, who uses an arc furnace. The criticism has, however, sometimes been made that an arc furnace does not exactly fulfill all requirements in zinc metallurgy, for the main reason that for zinc production not such a high temperature is required as is generated by the electric arc, and that it is rather more important to have the temperature under easy and absolute control. This may be more easily accomplished with a resistance furnace. Mr. W. McA. Johnson, who is known to have made extended experiments some years ago on electric zinc reduction for a Western zinc company, has recently patented a resistance furnace for the reduction of zinc ores and the distillation of the metal. It is in the form of an inclined, air-tight, rotating drum, composed of several independent and electrically insulated sections. Within the furnace walls longitudinal passages are provided, filled with powdered graphite serving as the heating resistor.

A patent for a simple and compact resistance furnace for melting down a charge has recently been granted to Mr. I. L. Roberts. The outer iron casing is lined with a mixture of ground asbestos and magnesium carbonate, well packed in place to provide good heat insulation. Inside of this is a chamber of firebrick within which is placed the iron crucible containing the charge. But between the walls of the firebrick chamber and the iron crucible, granulated or powdered coke, mixed or not with silica, etc., is provided to act as the heating resistor. Furnaces of this general type with a granulated resistor have already been used on a large scale by Mr. E. G. Acheson; a type of furnace with the crucible embedded in a granulated resistor has recently been studied in detail by Mr. F. A. J. Fitz Gerald; Girod has proposed such furnaces for steel refining; a granulated resistor material with the trade name of kryptol is now quite extensively used for laboratory purposes. The chief reason why this general type of furnace attracts so much attention lies in the fact that it permits a very easy regulation of temperature.

INDUCTIVE FURNACE.

The electric induction furnace was first tried independently by various experimenters in this country some sixteen years ago. Mr. A. E. Colby took out the fundamental patents in 1890. Direct commercial developments, however, did not result from this early work. The credit for having made the induction furnace a successful commercial instrument in steel metallurgy is due to Kjellin in Sweden. The subject is just now attracting much attention in this country, and only a few weeks ago the first induction furnace, designed by Colby, was given over to commercial practice for steel making at the Tacony works of Henry Disston & Sons, near Philadelphia. The designs of Colby and Kjellin are essentially the same. In each the crucible containing the charge is in the form of a horizontal ring, acting as the single secondary turn of the transformer which represents the furnace. This would, indeed, appear to be the most natural arrangement. The charge, representing the secondary of the transformer, is homogeneous. Recently, however, Mr. T. F. Snyder has patented a peculiar modification, the secondary being arranged in his case in a vertical plane. It is no longer homogeneous, but is composed of conducting materials of different specific gravity. Copper bars are at the bottom; above them rests the molten metal, above which there is the light slag. With this arrangement it is possible to produce different temperatures at different points of the secondary, and the inventor points out that he can produce the maximum heating effect at the top; that is, in the slag upon which the ore to be melted is fed.

FERRO-ALLOYS.

The chief technical difficulty of production of ferro-alloys in the electric furnace is to make them with a low contact of carbon. Mr. E. F. Price proposes in a recent patent to use low-carbon ferro-silicon as the reducing agent for the production of other ferro-alloys, like ferro-chrome, low in carbon. His process, therefore, consists of ten steps. The first is the production of ferro-silicon, high in silicon and low in carbon, which is commercially feasible. The ferro-silicon thus produced, is comminuted and mixed with chromite and lime and treated in an arc furnace for the production of ferro-chrome. It might be feasible to modify this process by making metallic silicon in the first stage and use this as reducing agent later on.

CALCIUM CARBIDE.

Three patents, recently granted, refer to the manufacture of calcium carbide. Mr. E. F. Price, of the Union Carbide Co., proposes to withdraw the waste carbon monoxide from the electric furnace and burn it in a preheating chamber through which the finely divided mixture of lime and coke is showered before being fed into the electric furnace. Mr. J. M. Morehead, who is also an engineer of the Union Carbide Co., patents a modification of the well-known Horry type of furnace. The essential feature is that a region of reduction is established under a gas-tight hood, the charge being fed into and downward within the hood into the region of reduction. The hood is sealed by a layer of the charge material extending below the lower end of the hood, and the waste gases are withdrawn from the hood.

Mr. J. E. Hewes endeavors to render the process of carbide production perfectly continuous, by placing trough-shaped hearth plates on an endless traveling chain and moving them below two adjustable electrodes.

LETTER TO THE EDITORS.

Lighting Franchise Conditions.

To the Editors of Electrical World:

SIRS: I notice in your last issue a very interesting statement from Mr. Freeman, of the Edison Electric Illuminating Company of Brooklyn, with regard to the dispute between his company and some of the city authorities as to the conditions involved in the exchange by the company of free lighting for its franchise, and note also your comment upon this situation and your remark that the exaction of free service from a company in part or whole payment for its franchise does not seem to work out well.

Broadly speaking, this is probably true, and it is doubtless not less true as regards street railway companies and the imposition often forced upon them to maintain in good shape the roadbed of the thoroughfares through which they run. If the street railway company had complete control of the roadbed it might execute its contract satisfactorily, but when several other parties are all the time pulling the roadbed to pieces a gross injustice is done the street railway company. In the same way, in view of the manner in which the technical conditions of electric lighting are changing in this country all the time, it is easy to see that serious complications may arise when a company has undertaken to string along its circuits so many free arc lamps for the city or so many incandescent lamps. If it changes to Nernst lamps or to Cooper Hewitt tubes, or even to the flaming arc, it is at once involved in a new reading of the contract and is more likely than not to suffer from any attempt at readjustment.

This whole question of the terms upon which franchises are granted is involved in confusion and doubt, and I would like to suggest through your columns that the National Electric Light Association might render a public service by compiling the data as to the terms on which the franchises of its member companies have been granted. Information has been forthcoming on this point from time to time, and it is not unlikely that we are reaching uniformity in practice throughout the country. But a report dealing with such franchises would be valuable and might be made a subject for the next annual meeting of the Association. We ought at least to have uniformity of practice in each state, and the trend of legislation is that way, but before any good legislation can be enacted it is necessary to know where we are at. I would suggest that in your own notes of new contracts made by the local lighting companies you give as fully as possible the terms of the contract upon which the franchise is issued or extended, as you did recently in connection with the new ordinance for the Detroit Street Railway.

ROCKLAND, ME. WELLMAN T. JONES.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Design of Shafts of Electric Generators.—Livingstone.—Some notes on the mechanical design of shafts for direct-connected generators. In such shafts the stresses due to bending are so high in comparison with the torsional stresses that the latter may be neglected. Although the shaft is really a continuation of the engine shaft, and the point of contrary flexure changes from *a* to *b* (Fig. 1) once every revolution, due to the thrust from the

FIG. 1.—DESIGN OF SHAFTS.

piston being downwards one-half of a revolution and upwards during the succeeding half, the assumption is justified that the point of contrary flexure may be at the center line of the engine bearing when calculating the generator shaft, and the shaft may be calculated as a simple beam supported on two bearings, the engine bearing at one end and the outboard generator bearing at the other. The stresses obtained in this manner are due to dead loads only, and a sufficiently high factor of safety should be used to take care of the increase of stress due to the eccentricity or out-of-balance of the rotor. As the stresses are alternating, the breaking load is a load which gives a much lower stress than the actual tensile strength of the material. A few results of tests by various authorities are shown plotted in Fig. 2. The unknown stresses are to such an extent dependent on the stiffness of the shaft that the allowable deflection is of even more importance than the calculated stress in the material when determining the shaft diameter. This is especially the case in machines which have an unbalanced pull when the rotor is displaced from its central position. For moderate speed machines the author gives the rule that the deflection should not exceed 10 per cent of the air gap. Equalizing rings on direct-current ar-

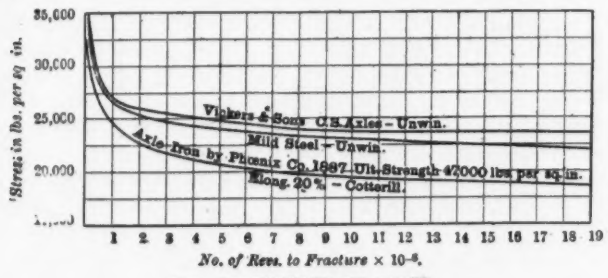

35,000
30,000
25,000
20,000
'Stress in lbs. per sq. in.
Vickers & Sons C.S. Axles - Unwin.
Mild Steel - Unwin.
Axle Iron by Phoenix Co. 1887. Ult. Strength 47,000 lbs. per sq. in. Elong. 20 % - Cotterill.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
No. of Revs. to Fracture × 10⁻⁶.

FIG. 2.—RESULTS OF TESTS.

matures are said to do away to a great extent with the unbalanced magnetic pull, and on such machines a slightly higher shaft deflection can be allowed, though in no case should the deflection exceed 20 per cent of the air gap. The author then gives some formulas based on the 10 per cent rule stated above, and arrives at the result that the diameter of the shaft at the center line of armature in inches should be $\sqrt[4]{W L^3}$ divided by a figure which is 38.0 for generators between 100 and 300 kw.; 42.2 for generators between 300 and 750 kw, and 45.4 for generators upwards of 750 kw. In this formula W is the weight of the fly-wheel, armature and commutator, shaft and unbalanced magnetic pull, while L is the length of span in inches as indicated in Fig. 1. While for moderate-speed machines the deflection should not be more than 10 per cent of the air gap, it should be less than 10 per cent for high-speed machines, while for low-speed machines it may be as high as 20 per cent. The author gives the following table as a guide for the allowable deflection.

	With unbalanced pull, per cent of air gap.	Without unbalanced pull, per cent of air gap.
Low speed, 0 to 150 r.p.m.....	12	20
Ordinary speed, 150 to 650 r.p.m...	10	15
High speed, 650 to 1,000 r.p.m.....	8	10

The author finally emphasizes that any sudden change in diameter of the shaft is bad, and that all changes in the diameter should be made as gradual as possible.—*Lond. Elec.*, July 27.

Testing Large Shaft Bearings.—Kingsbury.—When it was suggested to run the 5,000-kw generators which were proposed for the Niagara Falls Hydraulic Power & Manufacturing Company, and which were to have rotating field cores weighing approximately 100,000 pounds, at a speed of 300 r.p.m., the engineers of the Hydraulic Company felt that the work should not be undertaken until tests were made. The arrangement of these tests is described in detail and the results are given. It was found possible to run bearings with loads and speeds greatly exceeding the ordinary values in practice, even without water for cooling the bearing sleeve. The extreme case of a successful test is a run made under 94,000 pounds load at 1,243 r. p.m., with only a very small amount of water run through the bearing sleeve, merely for determining its temperature. The oil supply was cooled.—*Elec. Journal,* August.

Cascade Converters.—Arnold.—A description of some of the latest machines of the Arnold-Bragstad-laCour cascade converter type built by various European manufacturers. The principle of the machine has repeatedly been described in this journal.—*Elek. Bahnen.*, July 4.

Lamps and Lighting.

Train Lighting.—Prasch.—An article on the Leitner-Lucas train lighting system, which has been mentioned in the Digest. It has now been modified and simplified; formerly the generator coupled with the driving axle consisted of two dynamos mounted on the same axle, while it now consists of only one such machine, which is provided with two field windings and two pairs of brushes for the sake of voltage regulation at different speeds. *Elek. Neu. Anz.*, July 15.

Power.

Project of High-Tension Direct-Current Transmission to Paris.—An account of a project worked out by Blondel, Harlé and Mahl for power transmission from the Rhone River to Paris. Reference is made to long three-phase transmission lines like that of 200 miles at 60,000 volts from Colgate to San Francisco. It is believed, however, that with the direct-current series system of Thury it is possible to extend the distance of transmission. If the central point of the series of machines in the generating station and also the central point of the receiving station be earthed, the insulation required from line to earth is never more than half that corresponding to the total pressure. Thus with insulators capable of withstanding 50,000 volts, a line voltage of 100,000 volts may be employed; whereas, for this same working pressure on a three-phase system the insulators must withstand something like a maximum of 150,000 volts. In addition to the scheme now put forward a project is under consideration in the south of France, between Orlu and Bordeaux, where it is proposed to transmit some 24,000 hp over a distance of about 250 miles, and a scheme has been proposed to transmit 60,000 hp to Stockholm from a waterfall distant about 370 miles. The authors find a suitable source of power in a portion of the River Rhone, near the entry of the river into French territory, in the neighborhood of Bellegrade, a point situated about 400 km (about 250 miles) in a direct line, or approximately 450 km. (280 miles) following the road. A minimum of 80,000 hp is available, but for about 300 days out of the year the flow is nearly double that amount, reaching as much as 1,250 cubic metres (44,200 cubic ft.) per second when the river is in flood. The local conditions are such as to make a certain amount of storage and regulation possible, so that a very considerable proportion of the total power can be utilized. For this purpose an artificial lake in the plain of Collogny is suggested. It is proposed to provide in the power house a series of 48 continuous-current series-wound generators, each capable of an output of 1,000 amperes at a maximum e.m.f. of 2,500 volts. These ma-

chines would be divided into two groups of 24 each, and eight 10,000-hp turbines would be provided for each group. Thus every turbine would drive three generators in tandem through Raffard couplings. The machines would be connected electrically in series, and, of course, carefully insulated from the earth. The central point between the two groups is, however, earthed, so that the full-load difference of potential between line and earth would be 60,000 volts, although the total voltage at the extreme terminals would be 120,000 volts, rising to 130,000 volts on overload. The number of machines in service, and therefore the voltage, would be varied according to the load by short-circuiting and cutting out those not required, the current being kept constant at 1,000 amperes. The receiving stations in Paris would contain a similar series of motors whose central point would be earthed in a similar way. In the event of a breakdown of one line, the other half of the system could still continue to work, using the earth as return. The two transmission lines are to follow entirely different routes, avoiding towns as much as possible. It is estimated that electrical energy could be supplied at the secondary terminals of the receiving station for 0.6c. to 0.8c. per kw-hour.—*Lond. Elec.*, August 3.

Electric Power for Tunnel Construction.—OMMELANGE.—A fully illustrated article on the electric apparatus used for the construction of the Karawanken tunnel. The tunnel is five miles in length, and its construction was commenced simultaneously from both ends. Hydro-electric stations were erected on both sides of the mountain to provide the electric power for the construction of the tunnel, especially for ventilating, hauling, etc. On the southern side of the tunnel electrically-driven compressors are used to work pneumatic rock drills, while on the northern side electric drills are used. These are crank impact drills, the principle being the same as that of a spring hammer. They were first fitted with direct-current motors, but later on alternating-current motors were adopted and have been used ever since.—*Jour. of Elec., Power & Gas*, July 28.

Spanish Power Transmission.—A note stating that a scheme is in progress for supplying the town of Seville from a generating station at El Carchado, about 80 miles from the town, by means of a three-phase transmission at 50,000 volts. Three 1,500-hp turbines running at 400 r.p.m. will form the first installment of generating plant and these will drive alternators, generating at 5,000 volts, 40 cycles. In order to step up to the line voltage, seven single-phase, 600-kilovolt ampere transformers will be provided (one as spare), and another group of transformers in the sub-station at Seville will reduce the pressure to 3,500 volts. —*Lond. Elec.*, July 27.

Gas Turbines.—BECQ.—The first part of an article on the development of gas turbines with reference to the papers presented at a recent discussion of the subject before the French Society of Civil Engineers.—*L'Eclairage Elec.*, July 28.

Traction.

Polyphase Traction.—KUMMER.—A description of a new system of polyphase traction which is somewhat similar to the one proposed by Hallberg in ELECTRICAL WORLD, July 14, 1905. The system of the author, which is specially intended for getting high rates of acceleration and is thought to be primarily useful for subways and high-speed roads, is similar to the multiple-unit control insofar as all or nearly all axles carry motors which are controlled from one single point on the train. It is different from the multiple unit systems since not every car has its special trolley pole, controller and rheostat. The driving motors are induction motors of the squirrel-cage type, three-phase current of variable frequency being supplied from a single converter on the train. The system is believed to combine the advantages of locomotives and of trains made up of motor cars. The system is especially applicable for high-tension transmission. The electric equipment of the new system is heavier than with other systems, but it is thought that the cost of maintenance and repairs will be lower; further, during reducing speed and while running down grades it is possible to recuperate energy. The author describes his system as applied to a direct-current line at 2,000 to 5,000 volts. The converter is in this case a motor-generator consisting of a direct-current motor with an adjustable excitation circuit, and a three-phase generator which is separately excited with constant current. The primaries of the driving motors are connected in parallel to this three-phase generator. In the diagram given by the author notches 0 to 5 serve for starting and 5 to 8 for increasing the speed. By turning the handle from 8 to 5 the speed is reduced and energy is returned into the network. Four notches of the controller are providing for electric braking. When the circuit is closed, the converter begins to run first alone until the frequency of the secondary three-phase currents is reached at which the torque of the three-phase motors at 100 per cent slip is able to overcome the momentum of inertia of the train. Thereafter the slip of the induction motors decreases with increasing frequency until the normal value of the slip is reached, which is maintained up to controller notch 5, the frequency increasing continually. At the same time the torque of the induction motors remains constant from their start up to controller notch 5 if the primary current is maintained constant by careful regulation of the rheostat. By increasing the speed from controller notch 5 to 8, the torque decreases and the slip also decreases on account of the load decreasing in spite of an increase of speed. The patents have been acquired by the Oerlikon Company, which has already made a series of experiments.—*Elek. Bahnen.*, June 13.

Resistance and Inductance of Rails.—WILSON.—A mathematical note comparing the researches of experimental measurements of the effective resistance and inductance of steel rails with the values calculated from the formula of Kelvin and Rayleigh. At least in the case of effective resistance the agreement is fair.—*Lond. Elec.*, July 27.

Electrophysics and Magnetism.

Ratio of Electrostatic to Electromagnetic Units.—LORD RAYLEIGH.—Some notes on improved methods of determining the ratio of electrostatic to electromagnetic units, usually denoted by v and representing the velocity of light in the electromagnetic theory of light. The most approved methods involve the construction either of a condenser or of an electrometer, of which in the first case the capacity and in the second case the potential can be calculated in electrostatic measure. The author first discusses details of construction of a suitable condenser with notes on its calculation, and then makes some suggestions on the construction of an absolute electrometer which consists essentially of an inner cylinder moving coaxially in the interior of two fixed cylinders.—*Phil. Mag.*, August.

Magnetism and Elasticity.—HONDA AND TERADA.—The authors first refer to a formula of Thomson giving the relation between magnetism and the elastic properties of magnetic substances. The authors' latest results show that in Swedish iron and tungsten steel, much depends upon the succession of tension or torsion with respect to the magnetic field. This succession effect is specially marked in weak field, where the hysteresis is strong. The authors have reason to conclude that the influence of succession is altogether due to hysteresis. In nickel, as might be expected, it does not matter so much whether the force is applied before or after magnetization. Nickel steel is distinguished by its high susceptibility in weak fields. With weak fields, tension considerably enhances the magnetization, but not with strong fields. Torsion reduces the magnetization, except in weak fields. The amount of change varies in proportion to the percentage of nickel. Generally speaking, the agreement between the formulas and the experimental results may be described as good.—*Lond. Elec.*, July 27.

Radioactivity.—RUTHERFORD.—Two papers, the first of which deals with the retardation of the alpha particles from radium in passing through matter. The alpha particles from a thin layer of one kind of radioactive matter are all expelled with the same velocity and after passing through an absorbing screen, all emerge with the same, though diminished, velocity. The author has studied especially the photographic effects due to alpha particles and the brilliancy of scintillations produced by alpha rays in zinc sulphide. The question whether the alpha particle has a critical velocity below which it is unable to produce its characteristic effects is still open. Either there exists such a definite critical velocity (about .04 of the maximum velocity of the alpha particle from radium) or the velocity of the alpha particle decreases very rapidly when it falls below that amount. A special result of his investigation is the almost conclusive proof that the value of the ratio of charge to mass of the alpha par-

ticles is the same for the alpha particles emitted by radium, radium A and radium F. The same issue contains another paper of the same author dealing with the distribution of the intensity of the radiation from radioactive sources.—*Phil. Mag.*, August.

Electrochemistry and Batteries.

Electrolytic Precipitation of Gold from Cyanide Solutions.—Neumann.—A long paper on the efficiency of electrolytic precipitation of gold from cyanide solutions and on the materials which may be usefully employed for the electrodes in such processes. For the electrolysis of dilute cyanide solutions the lead peroxide anodes recommended by Andreoli are unsuitable since they are always more or less porous and the solution attacks the metallic lead below the peroxide. The ampere-hour efficiency of precipitating gold from such dilute solutions is exceedingly low and will be in the average far below 1 per cent, but this is not necessarily an obstacle to the employment of such methods, in view of the high price of gold and its high electrochemical equivalent. Carbon electrodes of a certain quality (especially Acheson graphite) are quite durable in dilute cyanide solutions and may be used under certain conditions instead of lead cathodes. They must be used if it is intended that the raw gold deposited on the same from the cyanide solution should be directly refined in a succeeding electrolysis, which can be done in a gold chloride solution containing free acid. In gold chloride solutions, to which sodium chloride is added to improve the conductivity, very high ampere-hour efficiencies may be obtained with low current densities. With such a process the whole subsequent treatment of gold-lead cathodes would be superfluous. The lead cathodes can alloy with only from 2 to 10 per cent of gold, while with electrolytic refining, the final product would be fine gold of about 0.988 purity, instead of raw gold of 0.800 or 0.900 purity.—*Electrochem. and Met. Ind.*, August.

Atomic Conductivities of Ions.—Blackman.—The fact that there exists a definite quantitative relation between molecular conductivities seems to indicate unmistakably that molecular conductivities are additive properties, i. e., that the molecular conductivity of any substance in aqueous solution is equal to the sum of the atomic conductivities of its constituent ions. No such regularity apparently exists between the molecular conductivities of the acids, but if the assumption be made that the atomic conductivity of the hydrogen ion is a function of the relative strengths of acids, then it is possible to calculate its value and consequently those of other ions.—*Phil. Mag.*, August.

Telegraphy, Telephony and Signals.

Telephone.—Crudeli.—A paper read before the Italian Electrical Association on the efficiency of transformation in microphones. The author assisted Majorana in a series of experiments which the latter carried out with various forms of coils for microphones. The object of his experiments was to find out if it is possible to obtain a better telephonic effect by varying the electromagnetic construction of the coils within reasonable limits. For this purpose they used not only ordinary coils, but also specially designed coils, among which there were some with closed cores, others made of soft steel wire, etc. Although a great number of different coils were tested, the results obtained showed that the telephonic effect was not improved to any considerable extent by any of the modifications. The author has, however, applied the results to theoretical deductions on the transformation going on in micro-telephones. He gives a formula for calculating the efficiency.—*Atti della Ass. Elettrot. Italiana.*, Vol. 10, No. 1, 1906.

Miscellaneous.

Accidents.—Rain.—The annual report of the electrical inspector under the British Factories and Workshops Act. The first part of the report deals with accidents at municipal electric stations. There were 174 non-electrical accidents (due, for instance, to the cleaning of machinery in motion, to the bursting of gauge glasses on boilers, etc.). Of these 174 accidents, seven were fatal. In the same stations there were 35 electric accidents, of which three were fatal, two occurring while cleaning switchboards and a third while adjusting brushes. Two of these three fatal accidents might have been avoided if rubber gloves had been used according to instructions. The second portion of the report deals with accidents in private stations in which there were 35 non-electrical accidents and 18 electrical accidents, none being fatal. The article discusses in general the provisions against accidents and safety rules.—Lond. *Elec. Eng.*, July 27.

Presidential Address.—Lankester.—His presidential address to the British Association for the Advancement of Science, which recently celebrated the 75th anniversary of its formation in York. The first part of the address gave a review of the increase of knowledge in the several branches of science during the last 25 years, while the second part dealt with "The advances of science as measured by the support given to it by public funds and the respect accorded to scientific work by the British Government and the community at large." The speaker emphasized the great neglect of science by officialdom in England.—*Lond. Elec.*, August 3.

BOOK REVIEWS.

Elektrische und Magnetische Messungen und Messinstrumente. (Electric and Magnetic Measurements and Measuring Instruments). By H. S. Hallo and H. W. Land. Berlin: Julius Springer. 517 pages, 343 illustrations. Price, 15 marks.

The authors have sought to present a practical textbook of commercial laboratory electric measurements in the hands of electrical engineering students, in a form somewhat resembling "Kempe's Textbook" in the English language.

The treatise commences with dimensions of units, the elementary principles of measuring, and the elementary secondary electric standards. The description then takes up the galvanometer, resistance measurement, current measurement, voltage measurement, power measurement, phase measurement, meters, standardization of instruments, magnetic measurements, and the measurements of capacity and of inductance.

The book is well illustrated and the treatment is clear. It is written by electrotechnologists for students of electrotechnology. The work would be greatly improved in subsequent editions by the addition of an index. The writers have largely introduced descriptions of European measuring apparatus; so that the treatise is less adapted to students of electrical engineering here, accustomed to American methods and apparatus.

The Seven Follies of Science. By John Phin. New York: D. Van Nostrand Company, 1906. 178 pages, 34 illustrations.

If we accept the definition of *folly* as given in a standard dictionary, we will have to quarrel with the author of the volume entitled "The Seven Follies of Science"; for, squaring the circle, trisecting an angle and doubling the cube are problems that engaged the attention of some of the most serious men and finest mathematicians of antiquity. Nor could the attempt at making a perpetual-motion machine be classed as a "folly" with any degree of propriety until, by the labors of Rumford, Young, Joule and others, it was shown that such a machine would be in open contradiction to laws of nature. Though the transmutation of metals, which is the fifth "folly" in order, was for ages very properly relegated to the limbo of imaginative chemistry, still we would hesitate to-day to deny its realization in view of the wonders of radioactivity which we are called upon to believe on the testimony of men who are anything but wild, speculative and dreamy as were the alchemists of old. That said, we like the work of Mr. Phin because it tells in simple, popular style of the ceaseless efforts of the human mind to overcome the difficult, grasp the futile and even to attempt the impossible.

On page 61 it is stated that Joannes Taisnerus, the Latinized form of Jean Taisnier, a Belgian writer of the sixteenth century, published a book in which considerable space is devoted to solving the problem of perpetual motion by using magnetic attraction as the motive power; but we are *not* told that this Taisnier was a plagiarist who copied his description of the motor almost verbatim from the second part of the famous *Epistola* of Petrus Peregrinus, *De Magnete*, written in 1269—a work which vies with Gilbert's *De Magnete* of 1600 as a great contribution to magnetics. Taisnier's work of 1562 as well as the first printed

edition of the *Epistola* of Peregrinus, 1558, can be seen in the Wheeler gift of the Library of the American Institute of Electrical Engineers.

The author has added a number of subsidiary "follies" which make pleasant and instructive if not utilitarian reading, such as ever-burning lamps, the power of sympathy, how to see through a solid brick and how a spider lifted a snake. The book concludes with thirty pages on illusions of the senses and curious arithmetical problems.

Mr. Phin, while modestly disclaiming all originality, has rendered the general scientific reader a valuable service by bringing together in compact form so much matter of historical importance, matter which shows so well the intensity, the impatience and the vagaries of the human mind in the quest of knowledge.

Power Operated Hatches.

Armor hatches have been a problem ever since the protective deck was introduced. Means must be provided for raising and lowering the hatch plate quickly and safely under all circumstances, and as the plate weighs sometimes as much as half a ton, the problem is by no means a simple one. The one thing essential to the safe handling of these heavy plates is that they be mechanically held at all times, so that they cannot drop or swing back. This result has been accomplished in the "long-arm" electrically-operated hatch gear, of which a new model, shown in the accompanying illustration, has just been approved by the Bureau of Construction and Repair of the United States Navy Department. This gear is so designed that the hatch while being operated is always under control and held firmly, at whatever angle the plate may be to the deck.

The two essential parts of this apparatus are the hatch lift, a cast-steel box containing the motor, controller and gearing, and the lever system for connecting the hatch lift with the plate, for operation and for locking the plate water-tight when closed.

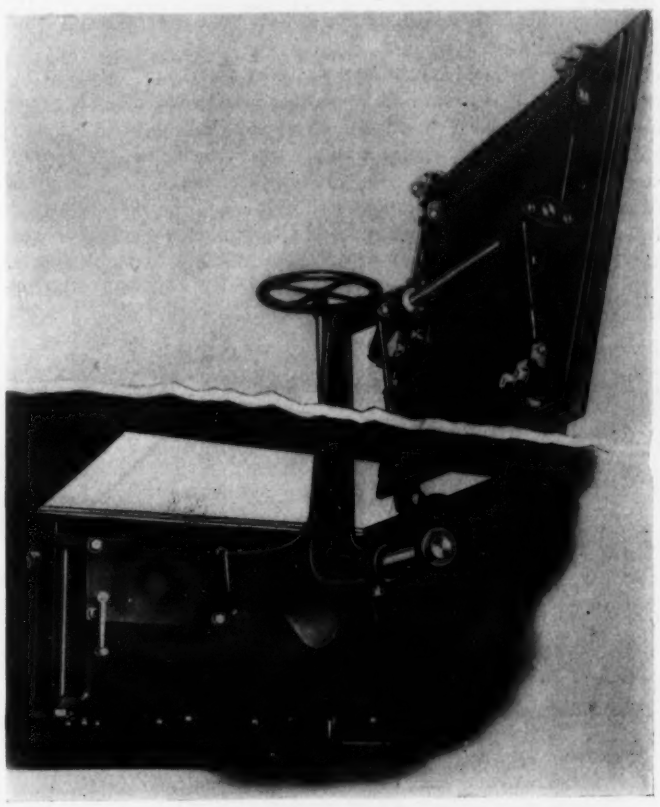
The hatch lift is secured under the deck by the side of the opening. Projecting from the side of the hatch lift is a heavy crank, which can be rotated either by the motor or by an auxiliary hand wheel, above or below deck. From this crank power is derived to open, close and lock the hatch plate. The lever system consists of a fulcrum shaft rotating in a bearing bolted to the underside of the protective deck, almost under the hinges of the plate. This fulcrum shaft carries a bent lever standing out beneath the hatch plate and connected to the locking mechanism on the hatch plate by a link. The bent lever does not obstruct the clearway when the hatch is open.

The locking mechanism consists of a number of bars all connected to one shaft across the center of the plate and so arranged that when the shaft is rotated the bars are forced out beneath the deck and draw the hatch plate firmly down to its seat. The mechanism is actuated by the lift, and does not require separate manipulation. When the hatch is closed and locked and the operator starts to open either by hand or power, the lift first unlocks the plate, after which it opens to any desired extent. A mechanically-operated stop prevents the locking gear from throwing out the bars except when the hatch plate is completely closed.

The motor and controller of the hatch lift are connected with a central emergency station located above deck, and form a part of the system by which the main bulkhead doors of United States warships are controlled from a central station. The hatch lift, in common with the "long-arm" system doors, possesses a "liberty action," which enables a man who may desire to pass through the hatch while it is being closed from the central station or after it is completely closed, to arrest and reverse the power action. This is accomplished easily and safely simply by turning the controller handle. When this lever is manipulated the closing operation is suspended and the hatch opens sufficiently to allow passage through the opening. As soon as the controller handle is released the hatch automatically closes again, as though no interruption of the emergency closing had taken place. The great importance of this feature of the mechanism is that it eliminates danger and gives freedom to those who may be compelled to pass through the hatchway while it is being closed from the emergency station.

In common also with the "long-arm" doors, the hatch lift is provided with an automatic cut-out so that in case an obstruction prevents the complete closure of the hatch plate, the current to the motor is cut off, preventing injury. After the obstruction is removed, the motor is automatically started, this follow-down action doing away with the possibility either that the apparatus will be injured or that, after an emergency closure is interrupted, the hatch will be left open by some one passing through it.

The hatch-gear described thus offers three methods of opera-



LONG-ARM HATCH GEAR.

tion, namely, at the hatch, both above and below deck, by power which is brought into action by means of the controller handle; above and below deck by means of the hand gear intended for use in case the electric power should fail, and from the emergency station on the bridge by means of which the closing of all power-operated hatches on the ship is always instantly possible.

Gasoline-Electric Railway Cars.

Attention has already been called in these columns to the Strang gasoline-electric railway car. We are now able to illustrate the experimental car that has been in service on the Missouri & Kansas Interurban Railway—on the Sante Fe Trail Route, hauling one or two trailers. In this car, the trucks carry the usual electric motors, and a gasoline engine drives the dynamo, which can furnish current direct to them or to the storage battery. Together with the regulating apparatus, the storage battery is the important feature of the system, as will be readily understood, for without it the engine large enough for the maximum load, would be too large and heavy to be practicable. While running on a level track under ordinary conditions the current goes directly from the generator to the motors, but when coasting down grade, slowing up or standing still, the surplus of current is taken up by the batteries and furnishes the extra power necessary for acceleration and for ascending steep grades. This arrangement is entirely automatic and does not need watching by the operator. It is, in fact, a double system, for if the engine should be disabled the battery itself will carry the car for 20 miles.

During a trial trip through the southern part of Kansas covering about 550 miles, the car averaged about 40 miles per hour, despite grades of 3½ per cent and curves as high as 16

degrees. Last April, the "Ogerita," as the car is called, began making regular trips on a line built by Mr. Strang, known as the Santa Fe Trail Route, and running between Kansas City and Olathe, Kan., about 22 miles. The car is now operating between Kansas City and Lenexa, the latter place being about 15 miles distant from Kansas City. Four round trips are made daily, and one or two trail cars are used. Not a single trip has been missed for any cause whatsoever since its initial run on this line.

To expedite the completion of this new line and no locomotive being available for handling steel and ties, the "Ogerita" assumed the role of a freight engine. The present equipment for the road is entirely inadequate to meet the heavy traffic conditions, but will be relieved when the two handsome new cars, one of which appears in the illustration (Fig. 1) are placed in commission, to take their regular turns with the "Ogerita." The cars for the line are being built by the J. G. Brill Co., and are mounted on that company's high-speed trucks. The car illustrated is the standard type of combination passenger and smoker used. The "Marguerite" has already had some trial trips and will be at once sent West to join the "Ogerita" and the "Geraldine."

The new cars measure 48 ft. over the end panels and 52 ft.

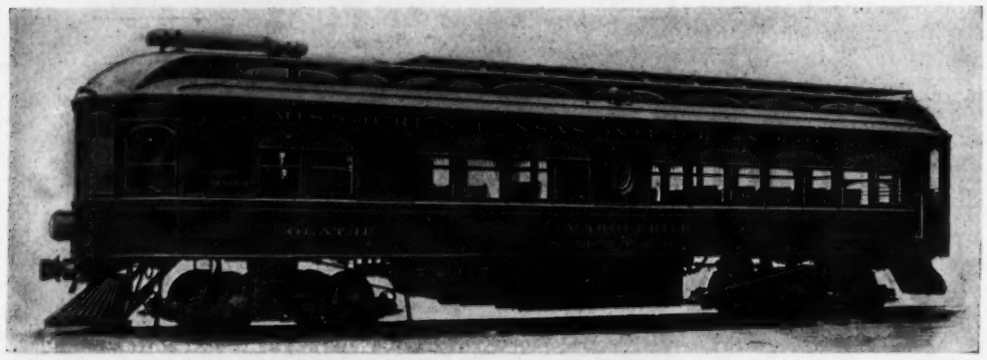


FIG. 1.—GASOLINE-ELECTRIC RAILWAY CAR.

9 ins. over the crown pieces; width over the sills, including sheathing, 9 ft. 6 ins.; sweep of the posts, 2 ft. 8 ins.; size of the side and end sills, 5¼ ins. x 8⅞ ins.; thickness of the corner posts, 3⅝ ins.; thickness of the side posts, 2¼ ins. x 4½ ins. The length of the passenger compartment is 27 ft.

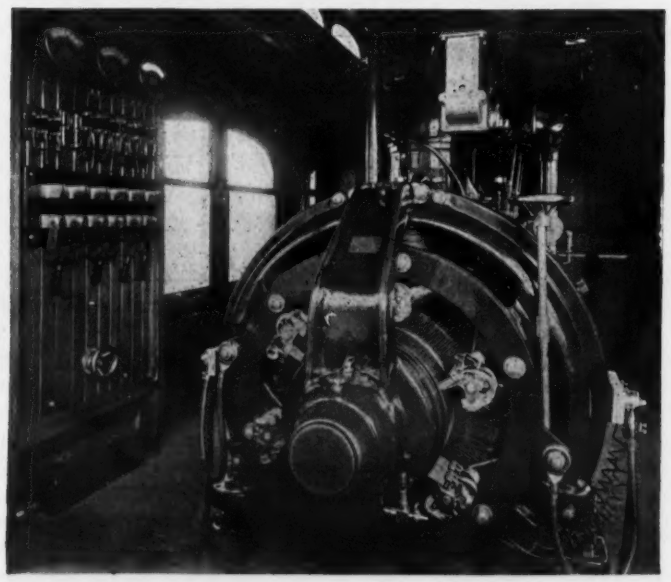


FIG. 2.—VIEW OF CAR PLANT.

5 ins.; the smoking compartment measures 10 ft. 8 ins.; while the engine-room is 14 ft. 8 ins. The seats are covered with red leather and harmonize with the green tint of the interior woodwork, and comfortable armrests are provided on the aisle side of the car. At the forward end of the passenger compartment and on the left-hand side of the car is a saloon with water cooler in alcove and a small folding lavatory with the usual adjuncts; the small oval window of opalescent glass will mark the position of the saloon in the picture. The engine-room, shown in Fig. 2, has a double window on the one side and a double sliding door on the other with a 5 ft. 6 in. opening. A removable partition is placed at the rear of the engine-room 2 ft. 8 in. from the partition, separating the engine-room from the smoking compartment, the space between these partitions to be used for a tankroom. The engine is of the four-cylinder vertical type, with 10-in. x 10-in. cylinders; the engine requires no attention while running, as the regulating apparatus is automatic. Hence one man can operate both the car and the engine.

Pole Line for Erie Traction Work.

Construction has now been begun on the overhead line of the Erie Railroad, between Rochester and Mount Morris, N. Y. It is to be a single-phase catenary mounted on wooden bracket poles on the main line, and carried on steel poles with span construction in the yards. The trolley wire is to be No. 3-0, carried on a single seven-strand 7/16-inch galvanized steel messenger, which is to be painted. The messenger cable is tested for 22,500 lb. The verticals which support the trolley wire from the messenger cable are spaced 10 feet apart, and consist of ⅝-inch rods. The drop forge hangers are made by the Electric Railway Equipment Company, of Chicago. The ears which grip the trolley and messenger cable are identical except in the type of jaw. There will be six different lengths of rods. The trolley wire is to be carried at a height of 22 feet from the rails in the clear, with a minimum height of 19 feet under bridges. Owing to the high tension used no feeders will be employed, and the line will be fed near its center at Avon.

The wooden poles are of chestnut, and vary in length from 35 feet to 55 feet, with an eight-inch top. The 55 ft. poles are to be used at points where the line crosses certain deck bridges, where the poles will be carried down and attached to the abutments. The wooden poles are spaced at a maximum of 120 feet apart, with a minimum of 80 ft. The pole brackets are T's 3 inch by 3 inch by 9 feet long. The bracket insulators are double petticoated porcelain, 5 inches high, and were supplied by R. Thomas & Sons.

The line will be fed by Niagara Falls power at 60,000 volts, transformed at the sub-station, directly to the trolley voltage of 11,000. The engineering work of this electrification is all under the direction of Westinghouse, Church, Kerr & Co.

Exhibits at the New Haven Convention.

At the convention of the Municipal Electricians in New Haven, last week, the following exhibits were made:

The Corning Glass Works, Corning, N. Y., exhibited an indestructible inner globe. After being used for some time in an arc lamp, and while still hot, this globe was plunged in cold water without cracking it. Also while in use, the exhibitor would hold ice against it without causing it to crack.

The Gamewell Fire Alarm Telegraph Co. exhibited many forms of apparatus for the transmission and reception of alarms.

The Batteries Supplies Co. exhibited its Gladstone-Lalande battery.

The Connecticut Auxiliary Fire Alarm Co. exhibited auxiliary fire alarm apparatus of an improved type.

The Leeds and Northrup Co., of Philadelphia, showed some excellent testing apparatus.

Holtzer Cabot Co. exhibited many forms of telephone and other apparatus.

Stanley & Patterson, Inc., made a display of Faraday bells.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Reports from all sections are highly satisfactory. Abundant crops and an oversold steel industry engender confidence that makes the outlook bright for a continuance of present prosperous business conditions. Each week brings a new high water mark in some department, and the net result is uniformly better than for the corresponding week in any previous year. The weather has favored both crops and the distribution of merchandise, while the latter is increased by seasonable bargain sales. Despite unprecedented preparations for business by liberal purchase of rolling stock, the railways are facing a serious traffic blockade that cannot be avoided when the crops begin to move freely. Earnings thus far reported for August were 11.7 per cent larger than last year. July foreign commerce for the whole country far surpassed the same month in any previous year, especially as to imports, which were close to the largest in any previous month, and at the port of New York alone for the last week there were gains of $5,891,468 in imports and $1,519,833 in exports, as compared with the same week in 1905. An upward tendency to pig iron prices was the only important development of the week in the iron and steel industry. Little foundry iron is available for this year's delivery, while the market is practically bare of Bessemer and basic for the balance of 1906. New business in finished lines, structural material or rails is not especially large, but specifications for the former are heavy. Copper ruled firm. One local selling agency booked orders for electrolytic copper for twelve foreign countries and sold 12,000,000 pounds for consumption in the home electrical engineering trades. Notwithstanding the increases in the productive capacities of most of the producers of domestic copper, demand keeps the world's total visible supply down to record low figures. Prices are strong and unchanged. Lake, sixty days' delivery, 18¾ to 18⅞c.; electrolytic, from September till November, 18½ to 18⅝c.; casting copper, thirty days, 18½c to 18⅝c. The number of business failures during the week ending August 16, as reported by *Bradstreet's*, was 143, against 137 the preceding week and 147 the corresponding week last year.

40,000 HP FOR DULUTH.—The plans of the Great Northern Power Company, of Duluth, Minn., for the development of water power in the Northwest are second only in scope to those so successfully carried out at Niagara; and when they are brought to full completion will provide for the transmission of 200,000 hp to an ever widening circle of users. Details have already appeared in these pages. The power plant which is now under construction will have an initial equipment for the generation of 40,000 hp, with an ultimate capacity in this one station of 80,000 hp. It is located three miles from the city limits of Duluth, on the St. Louis River, the distance for transmission to the distributing center being 14 miles to the cities of Duluth and Superior, where sub-station equipment will be provided. From the strategic position of the generating stations the future possibilities of the development may readily be surmised. The Mesabi and Vermillion iron ranges, in which the greatest iron mines of the world are located, lie from 50 to 75 miles to the northward of the plant and are destined eventually to be operated from it. Along the southern shore of the lake to the westward and within transmission distance are the Gogebic Crystal Falls and Gogebic iron ranges and the copper mines of the Calumet district. The railway and lighting interests of Duluth and Superior have already contracted for electricity from the new source, and the long harbor frontage of docks and warehouses offers great opportunities for the use of electric hoists, lamps, etc. The distance from the head gates to the power house is 2.8 miles, about 2 miles of which is canal and forebay. Over the remaining distance the water is carried through about 3,800 feet of wood stave pipe and about 1,000 feet of 7-foot steel pipe for each water wheel unit. The difference in elevation between forebay and power house is 378 feet. The building, which for the present will be 181.5 feet long and 77 feet wide, will be constructed of brick masonry with framing. The initial hydraulic apparatus consists of three turbine water wheel units, each designed for a capacity of 13,000 hp. They will operate at a speed of 375 r.p.m. from a fall of 389 feet. The wheels are furnished by the Allis-Chalmers Company, of Milwaukee, and are of the Francis single vertical type. The exciter outfit will comprise two single vertical impulse exciter wheels, each one developing 350 hp at 500 r.p.m. from a 336-foot head. The general scheme of the Great Northern development was originated by Mr. T. A. Cokefair, of Duluth, and was executed by the National Contracting Company under Mr. Cokefair's direction as chief engineer.

TO MANUFACTURE INCANDESCENT LAMPS.—Financial interests comparatively new to the electrical industry are now behind a new company—the Novelty Incandescent Lamp Company—which is being organized in St. Marys, Elk County, Pa., for the manufacture of incandescent lamps. This company is being operated on an entirely independent basis, it is announced, and no understanding or agreement as to methods or prices will be entered into with any existing association of manufacturers in this field. It is believed by the organizers that the character of the men committed to the company and the policies as to sales methods and prices which it is the purpose of the management to inaugurate will be sufficient to gain the interest and sympathy of lamp buyers. The product to be marketed will embrace the new "Elk Standard" incandescent lamps, "Novelty" miniature lamps and "Novelty" renewed lamps. For the manufacture of the new types of standard incandescent and miniature lamps, the company is now erecting a new building at Emporium, Pa., twenty-one miles from St. Marys. For handling the department devoted to renewed lamps, a two-story brick addition to the plant now occupied at St. Marys is in course of construction. The officers of the company are: R. K. Mickey, president and general manager, St. Marys, Pa.; Josiah Howard, vice-president, Emporium, Pa.; Joseph Kaye, secretary, Emporium, Pa.; A. F. Vogt, treasurer, Emporium, Pa. These gentlement, together with Mr. Henry Auchu, of Emporium, Pa., constitute the principal members of the board of directors. Reference to the following banking institutions establishes the financial responsibility of the concern: First National Bank, Emporium, Pa., and the Farmers' & Merchants' Bank, St. Marys, Pa. It is announced that in the near future the two plants of the Novelty Incandescent Lamp Company will have developed facilities for the production of 10,000 lamps daily.

SIGNALS FOR JAPAN.—The General Railway Signal Company has been awarded the contract for the complete automatic block signaling of the Nankai Railway Company of Japan. This is the first high-speed railway in Japan to be electrified. Inasmuch as the steam roads of Japan run notoriously slow speed trains, the equipment of a high-speed electric road will be a revelation which will doubtless force a rapid change of motive power throughout the empire. The system to be installed is known as the "Young" and is the same as is being installed by the General Railway Signal Company on the electric zone of the New York Central & Hudson River Railroad, the New York, New Haven & Hartford Railroad, and other high-speed lines. The Nankai Railway will be a direct current system. The track circuits for controlling the signals will be operated by alternating current supplied from a special single-phase transmission line running the entire length of the road, which is nine and one-half miles of double track. The signal line will be supplied from special steam-driven alternating current generators delivering 2,200 volts at 60 cycles. The blocks will average about half a mile in length. Each block will be provided with a home and distant signal. The signals will be operated by alternating current motors, taking current from the special signal line, transformers stepping down from 2,200 to 50 volts being employed. The lamps in the signals will also be served from the same transformers. The two-rail system will be used; that is, both of the traffic rails will be used for the return of the propulsion current. This is accomplished by the use of reactance bonds, which, while maintaining the requisite difference of alternating current potential between the rails, freely permit the passage of the direct propulsion current. The entire contrast for the equipment of the road has been awarded to Takata & Company.

GAS ENGINE ORDERS.—A. H. Alberger Company, of Buffalo, N. Y., manufacturers of Buffalo tandem gas engines, reports the following recent orders and shipments: Art Metal Construction Company, Jamestown, N. Y., one 300-hp single

tandem engine, direct-connected to a 175-kw General Electric direct current generator. National Metallurgic Company, Pittsburg, Pa., two 55-hp single tandem engines, belted to direct current generators for lighting, elevator service and general factory use. Columbia Nut & Bolt Company, Bridgeport, Conn., one 150-hp double tandem engine, belted, for general shop drive, to be operated with producer gas from Wile suction producer. The Garford Company, Elyria, O., two 200-hp double tandem engines and one 100-hp single tandem engine, all arranged for direct connection to Crocker-Wheeler direct current generators. Current will be used for general factory service, including lighting. Morse Iron Works, Erie, Pa., one 100-hp single tandem engine, belted to Burke direct current generator. Ransome Concrete Machinery Company, New York, one 60-hp single tandem producer gas engine, arranged for belting to direct current generator for general shop purposes. American Multigraph Company, Cleveland, O., one 80-hp single tandem engine, direct-connected to 60-cycle Crocker-Wheeler alternating current generator, for lighting and power use.

POWER IN MEXICO.—With a view to furnishing power to mines in the Etzatlan district of this State, Apolonio Garcia, of Guadalajara, Mexico, has made arrangements to increase the capacity of the hydro-electric plant on his Potrero hacienda near Tequila. The present capacity of the plant is 200 hp and the current is supplied to the town of Tequila for lighting and power purposes. Within four months the capacity of the plant will be raised to 500 hp and current will be then transmitted to Etzatlan district mines. The waterfall which is utilized on the Potrero hacienda is capable of generating 2,000 hp, and the capacity of the plant will be still further increased as mining and milling operations increase in the Etzatlan district. It is probable that a distributing station will be erected in the town of Etzatlan. The new hydraulic and electrical machinery will be at once transported overland to the plant. Cheap power will mean a great deal to the Etzatlan district, which promises to become one of the most important mining districts in this part of Mexico. It is likely that several concerns operating mines in that district will arrange to secure power from the Potrero plant. For some time it has been reported that the San Pedro Analco Mining Company would transmit power to the Etzatlan district following the completion of its 1,200-hp plant on the Santiago River near San Pedro Analco. This plant will be completed within a few months.

M. O. PLANT FOR ORANGE, N. J.—By a unanimous vote, the Common Council of Orange, N. J., has decided to proceed with the erection of a municipal electric plant for street lamps. The plant is to be built in conjunction with the water pumping plant, under a law which was passed by the Legislature last winter and in which there is no referendum. It was evidently overlooked by the legislators, who were careful to put a referendum in all the other municipal lighting plant bills before the Legislature. Complete plans and specifications for the plant will be submitted in September, and the bids for the work will be advertised for, to be received about September 20. It is expected that contracts will be awarded by October 10, and the plant will be completed, if the figures are satisfactory, by February. This will make Orange the first city in New Jersey to erect a municipal lighting plant. After the plant is in operation the question of going into the private lighting business will be submitted to the voters. At present Orange pays $85 per arc lamp of 2,000 candle power. According to Consulting Engineer Seymour, the cost under municipal operation will be less than $50 a year. Mr. Seymour is to run the plant for the city for six months after it is installed. The plant will be used also for pumping for the Water and Sewer Departments.

DEVELOPMENT AT DAYTON.—The Dayton Citizens' Electric Company, of Dayton, O., has increased its capital stock from $100,000 to $1,000,000. Officers have been elected as follows: Valentine Winters, president; Cyrus E. Mead, vice-president, and general manager; S. W. Davies, secretary. These with E. J. Barney, S. J. Patterson and P. N. Sigler are directors. Within the coming twelve months the company will spend more than $1,000,000 in new equipment. A contract for the underground conduit system has been awarded to the Standard Vitrified Conduit Company, of New York, 500,000 feet having been contracted for. The first shipment of material has arrived and work on the conduit system will start immediately. A contract will be placed in the near future for the power station and for the equipment. The new plant will be of the most modern type. An auxiliary company which will carry on the construction work of the plant is soon to be incorporated with $50,000 capital stock.

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph Company's instrument statement for July and seven months compares as follows:

July:	1906.	1905.	1904.	1903.
Gross output ...	227,755	114,897	80,348	69,194
Returned	70,757	63,979	42,842	44,116
Net output	156,998	50,918	37,506	25,078
Seven months:				
Gross output	1,389,612	1,012,517	672,032	669,258
Returned	429,092	347,521	290,032	279,257
Net output	960,520	664,996	382,000	390,001
Total output ...	6,658,778	5,145,560	4,161,517	3,540,321

These figures reflect a large business. The San Francisco renewals come gradually and are not therefore responsible for the showing of a gain of at least 450,000 subscribers in the seven months.

GENERAL ELECTRIC CO. is credited with the intention of putting up large works at East Boston, as a supplement to those at East Lynn, Mass., a few miles away. The Boston *Transcript* says: "It is rumored that a syndicate of prominent business men is planning to develop East Boston as a large manufacturing section. Definite lines of work have been mapped out looking to this end and the first step in the plans of the new interests is the location of the General Electric Company in that city, where the company has already leased a factory building and soon will start a shop employing three hundred hands. This move on the part of the General Electric Company is said to be due to the difficulty it has experienced in obtaining the right kind of labor in Lynn, where the company now employs about 10,000 hands. A number of other large manufacturing interests are contemplating locating in East Boston."

BALL ENGINE ORDERS.—The Ball Engine Company, Erie, Pa., reports a very brisk demand for its Corliss four-valve type of engine. Among recent orders are the following: One 700-hp cross-compound for City of Aurora, Ill.; one 800-hp cross-compound for National Tube Company, Pittsburg, Pa.; two 700-hp cross-compound for Duluth & Iron Range Ry. Company, Duluth, Minn.; one 600-hp cross-compound for Flint Light & Power Company, Flint, Mich.; one 700-hp cross-compound for Pennsylvania R. R. Company; one 550-hp single cylinder for Washington Electric Light & Power Company, Washington, Pa.; one 550-hp single cylinder for Natalbany Lumber Co., Montpelier, La.; one 400-hp and 320-hp single cylinder for Craddock-Terry Company, Lynchburg, Va.

THE ELECTRIC CABLE COMPANY, of 17 Battery Place, New York, has just received further orders from the New York Central and Hudson River Railroad Company and from the New York and Queens County Railroad Company for Voltax, the high potential insulating compound with which these railroads have been experimenting for some years. The New York Central will use this material extensively at High Bridge in the installation of the new electric railway work at this point. Among the other railway companies which are using this material are the Illinois Central and the Norfolk Lighting and Railway Company, of Norfolk, Va. The latter company will use Voltax compound for underground insulation work.

PRICE OF PLATINUM.—The price of platinum gives signs of advancing again. Platinum has gone up 15 per cent since last week, and 50 per cent higher in price than it was a year ago. The metal, which could be bought a week ago for $24, is now $28 an ounce. A year ago it sold for $18 and $18.50. The present price is three times that of fifteen years ago. According to reports circulated among refiners, the Russian Minister of Commerce is now considering measures either for placing a heavy export tax on the product or for prohibiting altogether its exportation, except after it has been refined in Russia.

FOREIGN TRADE.—The Bureau of Statistics, Department of Commerce and Labor, reports imports and exports of merchandise for July, and for seven months ending July 31 as follows:

MERCHANDISE.

July:	1906.	1905.	1904.
Imports	$107,621,490	$83,856,714	$71,193,943
Exports	111,550,440	107,934,424	85,223,479
Excess of exports ..	$3,928,950	$24,077,710	$14,029,536
Seven months ending July 31:			
Imports	$744,980,820	$673,798,148	$579,531,496
Exports	969,393,168	848,903,447	758,949,576
Excess of exports ..	$224,412,348	$175,105,299	$179,418,080

APPARATUS FOR INDIA.—The U. S. Department of Commerce and Labor reports that M. Karnick & Company, Basavangundi Road, Bangalore City, India, are interested in American goods, importing directly from the manufacturers. They now want the following: Machines for making burners for lamps of

different sizes, machines for making wicks for lamps, metal-embossing presses, strong and reliable motor cars and motors, and all kinds of electrical lamp materials. They state that they are ready to accept any kind of agency in their line.

TATOOSH ISLAND WIRELESS.—In connection with the U. S. Navy wireless station on Tatoosh Island, Wash., Mr. Concannow, of San Francisco, has received the contract to put up a power house, dwelling house, water tanks, oil tanks and two masts. This is a De Forest station of 15-kw capacity, with a 110-volt alternator, and whose storage batteries are charged from a generator run by a 30-hp gasoline engine. The station will be in commission in about sixty days. Mr. C. J. Loose is the navy electrician in charge.

CARSON CONSTRUCTION COMPANY.—The Carson Construction & Engineering Company has been formed with general offices at Scranton, Pa. Mr. George B. Carson and Mr. C. O. Dersheimer are among those interested. The former is a capitalist and director in several banks, including the Keystone, of which he is treasurer. Mr. Dersheimer is counsel for the Lehigh Valley Railroad Company, and a director of the Citizens' National Bank of Tankhannock. Other members of the concern are said to be well-known financial and business men.

THE STROMBERG-CARLSON MANUFACTURING COMPANY, of Rochester, N. Y., reports having closed contracts for switchboards for the following named places: Port Byron, N. Y.; Shickshinny, Pa.; Packwaukee, Wis.; Knoxville, Tenn.; Port Williams, Wash.; Waterport, N. Y.; Sioux City, Iowa; St. Marys, W. Va.; Shell Mound, Tenn.; Bridgeport, Minn.; Kentwood, La., and Palouse, Wash.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, announces the sale of a complete automatic telephone exchange of 2,600 lines immediate installation to the Richmond Home Telephone Company, of Richmond, Ind. This automatic equipment will replace the manual apparatus now in use by the Richmond Home Telephone Company.

AITON MACHINE COMPANY.—The Aiton Machine Company, of New York City, engineers and machinists, 126 Liberty Street, New York City, report that Mr. Arthur S. Beves has been made president. Mr. Thomas A. Aiton is vice-president and Mr. John S. Showell, secretary.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was animated by such important developments as the increase in the Union Pacific dividend, the inception of such payments on Southern Pacific common, and the announcement of the long expected rights on St. Paul stock. New high records were made in some cases, but activity was largely manipulative and professional, being centered in the so-called Harriman stocks and a few other leading issues. Industries as a class were rather neglected. Allis-Chalmers common advanced ⅜-point and preferred 2 points, the closing quotations being 18 and 48½, respectively. General Electric closed at 170⅜, which is the highest quotation of the week and a net gain of 3⅜ points. Westinghouse also closed at the highest figure of the week for that stock—155—being a gain of 3 points. The closing prices for American Locomotive were 70¼ for common and 113 for preferred. Among the tractions Brooklyn Rapid Transit closed at 78; Interborough-Metropolitan common 37½ (a again of 2¼), and preferred 78½, an advance of 3 points. Western Union Telegraph advanced 1 point, closing at 92¼, and the last price of Michigan State Telephone was 50. Other closing quotations are American Telegraph & Cable, 92; American District Telegraph, 37; Electric Storage Battery, 84¾, and Metropolitan Street Railway, 108. The curb market improved all around during the week, closing at nearly top prices. This improvement was based on the expansion of Stock Exchange transactions. The closing quotations of August 21 are given in the above table.

NEW YORK

	Aug. 14	Aug. 21		Aug. 14	Aug. 21
Allis-Chalmers Co.	16¼	19¾	General Electric	166⅝	169
Allis-Chalmers Co. pfd.	46	48¾	Hudson River Tel.	...	...
American Dist. Tel.	25	25	Interborough Rap. Tran.	...	...
American Locomotive	69¾	69¾	Mackay Cos.	73¾	74⅛
American Locomotive pfd.	113⅜	112	Mackay Cos pfd.	72¾	73
American Tel. & Cable	90	88	Marconi Tel.	...	42
American Tel. & Tel.	125	125	Metropolitan St. Ry.	...	106
Brooklyn Rapid Transit.	76¾	78	N. Y. & N. J. Tel.	...	...
Electric Boat	18	18	Western Union Tel	91	91¾
Electric Boat pfd	60	60	Westinghouse com.	150	150
Electric Vehicle	10	10	Westinghouse pfd.	...	...
Electric Vehicle pfd.	10	10			

BOSTON

	Aug. 14	Aug. 21		Aug. 14	Aug. 21
American Tel. & Tel.	132½	133½	Mass. Elec. Ry. pfd	69¼	72
Cumberland Telephone.	...	116⅞	Mexican Telephone	...	...
Edison Elec. Illum.	...	...	New England Telephone	130	130¼
General Electric	...	...	Western Tel. & Tel	...	...
Mass. Elec. Ry.	20	...	Western Tel. & Tel pfd.	...	85¼

PHILADELPHIA

	Aug. 14	Aug. 21		Aug. 14	Aug. 21
American Railways	53	53¼	Phila. Electric	8⅝	8⅝
Elec. Co. of America	11	11⅛	Phila. Rapid Trans.	30	30⅛
Elec. Storage Battery	71	73	Phila. Traction	89	...
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Aug. 14	Aug. 21		Aug. 14	Aug. 21
Chicago City Ry.	160	160	National Carbon.	86	83
Chicago Edison	...	...	National Carbon pfd.	118	119
Chicago Subway	46¼	54	Union Traction	...	...
Chicago Tel. Co.	...	120	Union Traction pfd	...	...
Metropolitan Elev. com.	28	27¾			

SALE OF TROLLEY SYSTEMS.—The New York, New Haven & Hartford Railroad Company has disposed of all its trolley companies in Massachusetts, Rhode Island and Connecticut to individuals, who have formed an association, to be known as the New England Security & Investment Company. This action, it is believed, was taken as a result of Gov. Guild's special message to the last Legislature, urging legislation which would prevent the transfer of Massachusetts transportation companies to aliens. The transaction involves the sale of more than 75 per cent of the street railways of Connecticut, including systems in the cities of New London, New Haven, Norwich, Stamford, Hartford, Willimantic and other towns in Connecticut, together with lines running into New York State and Rhode Island, and numerous lines in Massachusetts, including systems in the cities of Springfield and Worcester. The sale of the numerous street car systems at this time anticipates any court action which may have been contemplated by the law department of the commonwealth. According to the last report of the Railroad Commissioners of Connecticut, the Consolidated Railway Company, the holding company of the electric properties of the New York, New Haven & Hartford road, had a total of 209 miles of trackage. In addition the steam road controls the Hartford Street Railway Company, eighty miles, under the original corporate name; a number of lines in western Connecticut contiguous to New York State, which were operated under a holding company, and recently it bought the Torrington & Winchester Railway. In addition to the surface lines the Consolidated Railway owned several gas and electric plants which were taken over when local roads were purchased. The charter of the road was based upon that granted years ago to the Worcester & Connecticut Eastern Railway, which operated in the extreme northeastern part of the State and which had charter rights of remarkable scope. The charter of the Consolidated Railway Company was amended at the last session of the General Assembly, permitting it to merge the many local properties which had been purchased from time to time.

PITTSBURG REDUCTION POWER.—A special dispatch from Ogdensburg, N. Y., of August 18 says: "The Pittsburg Reduction Company by a deal completed to-day obtained absolute control of the extensive electric power facilities at Massena, N. Y. The company bought the controlling stock of the St. Lawrence County Electric & Water Company, capital $100,000; the St. Lawrence Water Company, capital $100,000, and the Massena Electric Light & Power Company, capital $50,000. The Pittsburg company recently purchased the St. Lawrence River Power Company, which owns the canal between the St. Lawrence and Grasse rivers, now developing 35,000-hp, with the ultimate capacity of 150,000 hp." The Pittsburg Reduction Company is controlled in Pittsburg by the Mellons, and was originally the result of the genius of the late Captain A. E. Hunt. The company first built its plant at New Kensington, which it still operates, and was the first to take advantage of the cheap power of Niagara Falls. A few years ago it established a large plant at Shawinigan Falls, Canada, and at Massena. It is the sole producer of aluminum in the United States, and has an annual output of 7,500,000 pounds. It has $600,000 of 6 per cent preferred stock and $3,200,000 of common, on which it pays 12 per cent. R. B. Mellon is president, C. M. Hall and Geo. H. Clapp, of Pittsburg, vice-presidents; A. V. Davis, of Pittsburg, secretary and assistant treasurer; R. E. Withers, treasurer and assistant secretary. The directors are R. B. Mellon, A. W. Mellon, C. M. Hall, George H. Clapp, D. L. Gillespie, Alvah K. Lawrie and A. V. Davis.

CHICAGO PNEUMATIC TOOL.—The excellent showing of the Chicago Pneumatic Tool Co. for the first half of the current

year reflects to a large extent the mining activity of the country. Earnings available for dividends in that period were about 5 per cent, or at the rate of 10 per cent a year. The net earnings for the first half of the current year were equivalent to 7.4 per cent on the capital stock, as compared with 6.7 per cent in the corresponding period of last year. For the year ended Dec. 31, 1905, the net earnings of the Chicago Pneumatic Tool Co. were $852,612, an increase of $382,033 over the preceding year. The earnings of $457,483 for the first half of 1906 were at the rate of about $915,000 a year. President Duntley says: "The increase in the earnings available for dividends for half the year, represents the results of increased business made possible by the additional manufacturing facilities and large expenditures for development work as compared with last year. While the company is earning approximately 10 per cent on the capital stock, the surplus is being used for increasing manufacturing facilities and for additional working capital. Unfilled orders on hand at present are greatly in excess of any previous time since the company's organization. This in connection with the increasing factory facilities and new tools developed, which are about to be marketed, makes prospects look encouraging for the balance of the year."

RAILWAYS GENERAL ANNUAL REPORT.—The Railway Company General has issued its annual report for the year ended June 30, 1906. The income account compares as follows:

	1906.	1905.	1904.	1903.
Income for year.....	$135,512	$38,215	$45,901	$75,532
Exp., rent, tax, etc...	15,916	14,473	7,482	7,445
Net profits	$119,596	$23,742	$38,419	$68,087

President E. R. Dick says: At a special meeting held September 18, 1905, the stockholders voted to reduce the capital of the company to $900,000 by canceling stock owned by the company, purchased in conformity with the laws of New Jersey. Concurrent with said concelation the value of the securities of the company was marked down to the extent of $149,903. During the past year the Elmira & Seneca Lake road and the Michigan Traction Co. were sold at satisfactory prices. During the past year the company has purchased at a discount twenty thousand shares of its stock which will be canceled by vote of the special meeting of stockholders called for September 17, 1906. With this cancellation the capital of the company will be reduced to $700,000. As the securities owned by the company are marked down as far as it is proper to mark them there will be left $193,389 as a total to the credit of the surplus account after the proposed reduction in capitalization. Through the sale of the properties above mentioned the company has been enabled to make a large reduction in its working force and salary account.

SALE OF INTERSTATE TELEPHONE.—At Trenton, N. J., on August 15, Mr. William H. Hancock purchased at public sale the assets of the Inter-State Telephone Company for $575,000. The only other bidder was Carroll Robbins for the mortgage holders. The terms of the sale were that the bidders must deposit $10,000 in cash, and, as Mr. Hancock was the only one complying with this stipulation, the assets of the company were sold to him. He says that the assets were purchased for the reorganization committee, consisting of R. I. Wright, of Allentown, Pa.; John Markle, of the Markle Coal Company, of Jeddo, Pa.; W. S. Hancock, of Trenton; Col. A. C. Bakewell, of New York, and G. N. Rickard, of Wilkesbarre, Pa. Mr. Hancock says there is to be no consolidation with the Bell Telephone Company. The assets purchased were the office building here, valued at $50,000; the Trenton Telephone Exchange, $40,000; the Trenton Telephone line, $400,000; the Bridgeton line, $50,000; the Millville line, $35,000; the Vineland line, $30,000; the Mount Holly Exchange, $25,000; the line from Trenton to Princeton, $3,000; the Bridgeton-Millville line, $8,000; the Millville-Pleasantville line, $10,000. The franchises were estimated to be worth $100,000, and there was $671,000 in bonds of subsidiary companies.

DIVIDENDS.—A semi-annual dividend of $3 per share has been declared on the preferred stock of the Houghton Street Railway Co., payable on October 1, 1906. A semi-annual dividend of $3 per share has been declared on the preferred stock of Whatcom County Railway & Light Co., payable September 1. The National Lead Co. has declared a quarterly dividend of 1 per cent on the common stock. The usual 1¾ per cent dividend upon the preferred stock was also declared. Directors of the American Railways Co. have declared the regular quarterly dividend of 1½ per cent on the stock, payable September 15. The directors of the Grand Rapids Railway Co. have declared a dividend of 1 per cent on the common stock, payable September 1. A dividend of 1¼ per cent has been declared on the preferred stock of the Rochester Ry. & Light Co., payable September 1. Directors of the Kansas City Railway & Light Co. have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable September 1. The Northern Texas Electric Co. has declared a dividend of $2 on the preferred stock, payable September 1.

GENERAL ELECTRIC EARNINGS.—The business of the General Electric this year has increased at a very rapid rate, says the *Wall Street Journal.* This is particularly true of the rate of increase in earnings as the year has advanced, and the prospects are that the return to be made by the next annual report will be very good. It will probably be found to be conservative to estimate the gross business done in the current year at $55,000,000. In fact, in the last few months the business has been on such a large scale that it will not be altogether surprising if the gross earnings go considerably beyond this figure. The company is making extensive additions this year to its factory capacity in order to keep up with the growing volume of its business. By the end of the year it will have 600,000 square feet of additional floor space. At present the floor space in its factories aggregates over 4,300,000 square feet. Roughly speaking, it can be expected that the 600,000 square feet increase in the floor space will increase the productive capacity of the plants by about $6,000,000 per annum.

LAKE SUPERIOR POWER.—The United States Circuit Court of the Western District of Michigan has granted permission to Receivers C. D. Warren and Clarence M. Brown, of the Michigan Lake Superior Power Company, to issue $500,000 receivers' certificates. The receivers will dispose of these certificates immediately. They will probably be placed with Philadelphia and New York banking houses, although the bondholders may be given the opportunity to subscribe to a portion of the issue. The proceeds will be used to complete the necessary improvements to the power plant, so that it can be brought to its maximum capacity. The Lake Superior Corporation has guaranteed that the $500,000 will cover the cost of all necessary improvements. The Union Carbide Company, which now has a considerable contract with the power company, has also agreed to take as much additional power as can be allowed it when the improvements are completed.

NORTHWESTERN ELEVATED STOCK.—An increase of $3,000,000 in the preferred stock of the Northwestern Elevated of Chicago has been certified to at Springfield. The authorized amount of this stock is $25,000,000, and this increase brings the amount issued up to a total of $8,000,000. The reason for the increase is that the company proposes to issue bonds in an amount not to exceed $3,000,000 for the building of the Ravenswood extension and for other betterments and improvements and the bonds are convertible into preferred stock. The stock increase provides for the conversion. The bonds to be issued are part of a lot of $10,000,000 authorized for the building of extensions, the acquisition of additional property or the purchase of the securities of other roads. Arrangements for selling them have not been made as yet. Northwestern bonds of the same class sell in the market around 91.

CONSOLIDATED TELEPHONE.—Advices from Buffalo of August 21 report that B. G. Hubbell, president of the Consolidated Telephone Company, is authority for the statement that the Consolidated Company has bought from the Great Eastern Telephone Company the franchise to maintain and construct telephone and telegraph lines and electric lights in New York City. The amount paid is said to be $50,000,000, but Mr. Hubbell would not confirm this extravagant figure. A syndicate is to be formed, it is said, to take the franchise, and an operating company will be formed later to operate an independent telephone service in New York in connection with seventy independent companies controlled by the Consolidated Company.

STOCK OF PITTSBURG UTILITIES.—The stockholders of the Philadelphia Company have ratified the proposition to increase the capital stock of the corporation from $36,000,000 to $42,000,000. It was explained that the increase had been arranged to give the company revenue to make contemplated improvements to the lines of the Pittsburg Railways Company, the Allegheny Light Company, and other subsidiary companies.

CANADIAN BELL TELEPHONE.—The directors of the Bell Telephone Co., of Canada have increased the capital from $9,000,000 to $10,000,000. The new stock will be issued at 125, at the rate of one share of new stock for every nine shares of old.

CUMBERLAND TELEPHONE.—The Cumberland Telephone & Telegraph Company shows gross $445,081 for July and $3,080,819 for the seven months, whose net is $1,081,585, and surplus $937,163.

GENERAL NEWS.

Construction News.

MOBILE, ALA.—Work has commenced on the foundation of the new power house of the Mobile Electric Company which is to be erected upon the property of the company in St. Louis, between St. Joseph and Royal Streets. The new plant and electrical equipment will represent an investment of nearly $300,000.

ANNISTON, ALA.—Bids will be received until September 20 by Thomas E. Kilby, Mayor, for furnishing and lighting 100 electric arc lamps for a period of 10, 20 and 30 years from July 1, 1908, and for maintaining the same; also a franchise for the privilege of supplying electricity for all purposes to corporations and private citizens.

MOBILE, ALA.—Bids will be received by Patrick J. Lyons, Mayor, until Oct. 1 for the erection and equipment of a municipal electric light plant on city property, of 450 kw, divided into three units; also 600 arc lamps and power line complete, together with main station, stack and substation. Plans and complete specifications can be had on application.

BISBEE, ARIZ.—The Copper Queen Mining Company will install electric motors in its ore cars in the near future.

WYNNE, ARK.—The city contemplates changing the system of the municipal electric lighting plant from direct to alternating current and will extend the electric light lines and water mains into new districts. The change will necessitate the purchase of a 225-hp engine and an alternating-current generator of 150-kw capacity. The present street lighting system will be replaced by alternating-current arc lamps. John M. Covey is manager.

VENTURA, CAL.—The Ventura Water, Light & Power Company contemplates extending its lines into the suburban districts, and will build a transmission line for light and power, having a potential of 33,000 volts. James E. Barker is manager.

OROVILLE, CAL.—The new power plant of the Oro Water, Light & Power Company, situated a few miles above Pentz, is completed and has been put in operation. Several dredges owned by the company will be operated by electricity from this plant. The plant has a capacity of more than 5,000 hp.

SAN DIEGO, CAL.—E. S. Babcock, president of the San Diego Beach Railway, has filed a trust deed conveying the property to the Los Angeles Trust Company, to secure the payment of $706,000 40-year first mortgage bonds. It is stated that the proceeds will be used for the purpose of extending the road in San Diego, Orange and Los Angeles counties.

SAN FRANCISCO, CAL.—The Haight Street Improvement Club is taking subscriptions for the installation of 75 arc lamps, or ten lamps for each block, on Haight Street from Baker to Stanyan. The installation of the proposed system of lights will cost about $3,000. After purchasing the lamps and putting them up, the club will ask the city to bear the cost of maintenance.

SANTA BARBARA, CAL.—The Merchants Mutual Electric Light & Power Company is now constructing a transmission line 12 miles in length, having a potential of 11,000 volts to supply light and power through Goleta Valley. The company also contemplates making extensive additions and improvements to its plant during the coming winter. F. W. Hunter is general superintendent.

MARYSVILLE, CAL.—Work is progressing on the line of the Northern Electric Railway from Oroville Junction to a point some distance below Maryville. The Bay Counties Power Company is now having surveys made for the power lines to supply electricity for the new road and the poles will be set and the wires strung without delay. The building of depots and sub-stations will soon commence.

ALTURAS, CAL.—The Alturas Electric Light & Power Company has made arrangements with the Surprise Valley Electric Company, which has recently been organized, to furnish it with 100 hp. A transmission line, 23 miles in length, will be erected from the power house to Cedarville, where the electricity will be distributed throughout Surprise Valley. A large number of motors have been put in by house-holders and business houses in Alturas and vicinity. The machines will be used chiefly for pumping, and are fast taking the place of windmills, which up to the present have been relied upon to furnish water for drinking and irrigation. D. E. Mulkey and I. W. Gibbins are the principal owners of the Alturas Electric Light & Power Company.

SANTA MARIA, CAL.—The Valley Electric Company is now making experiments which requires the building of 5 miles of 11,000-volt transmission line, with a view of furnishing electricity for pumping water for irrigating 8,000 acres of land for the Union Sugar Company. If successful the company will build 20 miles of transmission line having a potential of 11,000 volts and will also furnish 1,000 lights for the factory. The company also contemplates building a transmission line to Guadalupe, a distance of nine miles, to furnish electricity for light and power. The Pacific Coast Railroad (a steam line) is now operating 4½ miles of line by electricity for freight hauling from the beet fields for the sugar company. If satisfactory the system will be increased to 20 miles. The Valley Electric Company is furnishing the electricity for operating the road.

FLORENCE, COL.—A franchise has been granted by the City Council to the Mineral Belt Railway Company, for a belt line around the city of Florence. Surveys are now being made for the line.

MERIDEN, CONN.—The Meriden Firearms Company is considering the erection of a new power house at its plant, and will install a 35-hp motor.

WASHINGTON, D. C.—Bids will be received until Sept. 4 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the Navy Yards, at Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Annapolis, Md.; Washington, D. C.; and Norfolk, Va., a quantity of naval supplies as follows: Schedule 102—Batteries; electrical supplies; ties; rails, asphalt paving blocks, etc. Schedule 104—Testing machine, etc. Schedule 106—Pumps, etc. Applications for proposals should designate the schedule desired by number. H. T. B. Harris, Paymaster-General, U. S. N.

WASHINGTON, D. C.—Bids will be received until August 28 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the Navy Yards, etc., Portsmouth, N. H.; Boston, Mass.; New York, N. Y.; League Island, Pa.; Annapolis, Md.; Washington, D. C.; and Norfolk, Va., a quantity of naval supplies as follows: Schedule 94—Armature, ammeters, etc. Schedule 95—Bar steel, bar iron, copper wire, etc. Schedule 96—Wattmeter, etc. Schedule 97—Hydraulic jacks, lever jacks, spur-geared hoists. Schedule 98—Steel enameled conduit, conductor; electrical supplies, brass, bar iron, bar steel, galvanized sheet steel, brass pipe, iron pipe, brass and iron pipe fittings, cocks, valves, etc. H. T. B. Harris, Paymaster-General.

JACKSNOVILLE, FLA.—Two Allis-Chalmers steam turbines of 1,000-kw capacity will soon be installed in the municipal electric lighting plant. R. N. Ellis is superintendent.

BRAIDENTOWN, FLA.—The Manatee Light & Traction Company contemplates installing a condenser and heater in its plant and laying a two-wire, 2,300-volt cable under the Manatee River. M. H. Wheaton is manager.

ST. AUGUSTINE, FLA.—The St. Johns Light & Power Company is erecting an electric plant in this city for the purpose of furnishing electricity for lighting and power purposes, and for operating a street railway. T. R. Osmond is secretary.

BOSTON, GA.—H. C. Jordan, city clerk, writes that bonds to the amount of $10,500 are about to be sold for the construction of an electric light plant.

ACKWORTH, GA.—J. B. McCreary & Company, of Atlanta, have secured the contract for constructing water works and an electric light plant at Ackworth.

FORT VALLEY, GA.—The citizens are contemplating operating the water pump by electric power furnished by the municipal electric light plant. J. L. Finch is mayor.

MOULTRIE, GA.—Extensive improvements and additions are contemplated to the municipal electric lighting plant. The frequency will be changed from 133 to 60 cycles and a 200-kw generator will be installed. H. Y. Barr is superintendent.

COMMERCE, GA.—Carter & Gillespie have secured the contract for the construction of the electric light plant for the Harmony Grove Mills. A 70-kw General Electric alternator and a 100-hp Harrisburg engine will be installed in the plant. M. Sears is superintendent.

SAVANNAH, GA.—The new electric plant of the Savannah Lighting Company which is being erected on Montgomery and Fifty-second Street, is nearly completed and will soon be ready for operation. The equipment of the plant consists of three alternators of 1,100-kw capacity, a 750-hp turbine made by the Allis-Chalmers Company, 900-hp engines made by the Harrisburg Foundry & Machine Company, and Babcock & Wilcox boilers. W. A. Burney, Jr., is manager.

HAILEY, IDA.—The Cramer Electric Company is contemplating installing motors for power service. John Cramer is secretary and treasurer.

SANDPOINT, IDA.—The Pend d'Oreille Electric Company will install a new engine of not less than 266 hp and boiler of 100 hp; and will also construct a hydro-electric plant and erect a transmission line 16 miles in length to deliver 500 hp at Sandpoint. J. F. Reynard is manager.

ELGIN, ILL.—The Council has granted a 25-year franchise to the Elgin Electric Light Company.

GALESBURG, ILL.—The Peoples' Electric Power Company has made application to the City Council for an electric franchise in this city. Charles S. Harris is president.

DECATUR, ILL.—Work has commenced on the improvements to be made to the power house of the Decatur Railway & Light Company in this city. The cost is estimated at $30,000.

COFFEEN, ILL.—Plans are being prepared for the construction of an ice plant in this city, to be operated in connection with the new electric light plant. C. F. Edwards is owner of the electric light plant.

MORRISVILLE, ILL.—The Springfield, Clear Lake & Rochester electric interurban line, now being constructed out of Springfield to Rochester, is to be immediately extended through Pawnee to Morrisville and Hillsboro

AURORA, ILL.—The J. E. Salfishburg Company, of this city, has commenced work on the excavation for the foundation for the addition to the electric light plant which is to be erected by the Ball Electric Company, of Chicago.

VAN BUREN, IND.—At a recent meeting of the directors of the Van Buren Telephone Company, it was decided to rebuild the system, make some extensions and install new equipment.

INDIANAPOLIS, IND.—Bids will be received until Aug. 29 by the Board Public Works, for furnishing material and erecting a power plant in the new power house at the City Hospital.

GREENWOOD, IND.—The Citizens Water & Light Company contemplate extending its line to Southport, a distance of 3½ miles, and will furnish an incandescent street service. J. A. Craig is manager.

NOBLESVILLE, IND.—Harry McGrath, secretary Noblesville Hydraulic Company, writes that the company expects to begin work on its plant about Sept. 1. This company has the contract for furnishing electricity to Noblesville for three years.

NEW CASTLE, IND.—Work has commenced on the construction of the power plant of the Indianapolis, New Castle & Toledo Traction Company, which will include, in addition to the main power station and equipment, 10 permanent and one portable sub-stations. D. M. Parry is president.

NEW ALBANY, IND.—The Louisville, New Albany & French Lick Traction Company has been granted a right of way through the towns of Paoli, Hardinsburg, Fredericksburg, Palmyra and Greenville, and also through Orange County. Petitions for right-of-way through Floyd County and in New Albany have been filed.

BERWYN, I. T.—The Washita Electric Light & Power Company is contemplating the development of Washita River. W. F. Whittingdon, of Ardmore, is one of the promoters.

SIOUX CITY, IA.—It is reported that W. R. Burch and associates have bought the Sioux City, Homer & Southern Electric Railroad, and will complete the line to the Winnebago Indian Reservation, through which the line has a permit to operate.

MADISONVILLE, KY.—Jas. L. Brown, city clerk, writes that the Machinery Sales Company, of Cincinnati, Ohio, has secured the contract for the machinery for the electric light plant. The contract for outside construction has not yet been let. In all about $25,000 will be expended. H. C. Morton, of Madisonville, is the engineer.

NAPOLEONVILLE, LA.—At a meeting of the Town Council held recently a committee was appointed by Mayor Gilbert to look into the cost of an electric light plant for the town.

PASCAGOULA, LA.—The Pascagoula Street Railway & Power Company expects to replace its arc lighting system in Moss Point with fifty 32-cp incandescent lamps. S. S. Bush is manager.

ABBEVILLE, LA.—The Abbeville Electric Light and Power plant, owned by Sokoloky & Wanca, was destroyed by fire on Aug. 11. The town will be without electric service until the municipal plant is ready for operation, which will be in about two weeks.

CROWLES, LA.—Geo. W. Horton, city clerk, writes that bids will be received about Oct. 5 for water works, an electric light plant and other municipal improvements at South Crowley. About $100,000 in bonds will be issued for the work.

GRAFTON, MASS.—The Uxbridge Electric Light Company has recently established a 24-hour service for lighting in the southern part of the town.

PLYMOUTH, MASS.—The Plymouth Electric Light Company has completed its transmission line to Duxbury, a distance of nine miles, and is now supplying electricity for lighting the town.

PEABODY, MASS.—A new engine is being placed in the power house of the A. C. Lawrence Leather Company and is expected to be in running order by Sept. 1. The company will operate its new plant just completed by electrical power. It is expected that the company will also furnish electricity for the new Waters River plant now being erected.

MILO, ME.—Fred W. Bolster as been awarded the contract for the construction of the new power station of the Milo Electric Light & Power Company. Work will soon commence on the building.

AUGUSTA, ME.—Arrangements are being made for the enlargement of the wheel house of the Brown mills. An additional wheel will be installed which will increase the power about 50 per cent. A new dynamo will also be installed to furnish electricity for lighting the mills.

MILES, MICH.—The City Council has granted the Chapin Power Company, of Buchanan, a franchise to transmit electricity to Niles for manufacturing purposes only.

DETROIT, MICH.—At a special meeting of the Detroit Edison Company, an issue of $1,000,000 6 per cent debenture bonds was authorized. Only $500,000 will be sold at present, the proceeds to be used for additions and improvements.

LAPEER, MICH.—The electric light plant owned by J. Schlegel is completed and is ready for operation with the exception of setting the poles and wiring. The equipment consists of a 100-kw, three-phase, 60-cycle Westinghouse alternator and a Leffel water wheel of 200-hp capacity. A company will soon be organized to operate the plant.

SAULT STE. MARIE, MICH.—The United States Circuit Court has granted permission to Receivers C. D. Warren and Clarence M. Brown, of the Michigan Lake Superior Power Company, to issue $500,000 receivers' certificates. The proceeds will be used to complete the necessary improvements to the power plant, so that it can be brought to the maximum capacity. The Union Carbide Company, which has a contract with the company, has agreed to take as much additional power as can be allowed when the improvements are completed.

BELLE PLAINE, MINN.—J. R. Stratton and associates have secured a franchise for an electric light plant.

NORTHFIELD, MINN.—The Council is considering the question of installing a municipal telephone system.

GRAND RAPIDS, MINN.—The Mesaba Telephone Company will make improvements to the local system and will erect a new central building.

PAYNESVILLE, MINN.—The Village Council has decided to add to the electric light plant a new dynamo and engine and other necessary machinery.

STAPLES, MINN.—Bids will be received until Aug. 31 for water works and an electric light plant. J. D. Marlin is Village Recorder. Claussen, Burch & Pillsbury, St. Paul, are the engineers.

EVELETH, MINN.—The City Council is said to be considering the question of establishing a municipal electric light plant at St. Mary's Lake, in conjunction with the water pumping plant.

RED WING, MINN.—The American Electric Company, of St. Paul, has been awarded the contract for the general repairs and generators for the Red Wing Training School and the Faribault institutions. A contract for the engines, pumps and feed water heaters for the buildings was awarded to R. B. Whitacre, of St. Paul.

MENDENHALL, MISS.—The Board of Aldermen has granted A. W. Dent, L. E. Magee and associates a franchise for an electric light and power plant.

CANTON, MISS.—Extensive improvements and additions are to be made to the municipal electric light and water plant. The system will be changed to three-phase, 60 cycles, 2,300 volts. A 200-kw, three-phase, 2,300-volt revolving field generator and a 2½ million gallon triple expansion or compound steam pump, for water works service will be purchased. A 75-kw generator, direct connected to a high-speed engine will probably be installed. An alternating-current day service is also comtemplated. John T. Sharp is manager.

ILLMO, MO.—The Kelso Telephone Company has increased its capital stock from $5,000 to $10,000.

NEW MADRID, MO.—Harry B. Day, owner of the electric light plant, will build a new plant this summer.

SHELBINA, MO.—A new boiler will be installed in the municipal electric light plant. E. P. Weaver is superintendent.

BALLWIN, MO.—The Ballwin Mutual Telephone Company has filed a statement of increase of capital stock from $2,000 to $12,000.

LEES SUMMIT, MO.—L. Screechfield & Son, owners of the electric light plant, are contemplating installing a storage battery equipment.

CAMERON, MO.—John Abbott Clark, city attorney, writes that the proposed improvements to the water and electric light plant will cost about $9,000.

JEFFERSON CITY, MO.—The Jefferson City Light, Heat & Power Company contemplates rebuilding its boiler plant and outside lines. P. A. Bertrand is manager.

ST. CHARLES, MO.—The St. Charles Electric Light & Power Company will rebuild its plant in the near future, and will change the frequency from 133 to 60 cycles. Charles Z. Pierson is manager.

CLINTON, MO.—Bids will be received until Sept. 18 by G. V. Berry, city clerk, for furnishing material and constructing a water works system and an electric light plant, including power house, reservoir, pumping machinery, etc. Burns & McDonnell, Kansas City, Mo., are the engineers.

MARYVILLE, MO.—At the last meeting of the City Council, J. C. Donnell, manager of the Maryville Electric Light & Power Company, withdrew the proposition the company had submitted to the Council for furnishing electricity for lighting the city. The Council is now having estimates made on the cost of putting in a plant that will be sufficient to meet the growing demands of the city. As soon as an ordinance can be drawn by the city attorney, a proposition will be placed before the people to vote on municipal ownership.

HELENA, MONT.—The Capital City Improvement Company has petitioned the U. S. Land Office at Helena, for permission to flood lands, etc., along the Missouri River below the dam now building at Hauser Lake. It is said that the company proposes constructing a dam for power purposes.

LEXINGTON, NEB.—The Lexington Mill & Elevator Company contemplates enlarging and extending its plant. A. P. Jensen is secretary.

HOLDREDGE, NEB.—The Holdredge Lighting Company will rebuild its plant and will change the frequency from 133 to 60 cycles. L. J. Schwingel is manager.

CRAWFORD, NEB.—A new electric lighting plant is being erected in this place, and is expected to be in operation about Nov. 1. S. A. Oliver is owner and manager.

RED CLOUD, NEB.—Work has commenced on the construction of the municipal electric light plant in this city. John Martz is engineer and will have supervision of the work.

WAYNE, NEB.—Plans have been drawn and an appropriation of $3,500 made for the rebuilding of the transmission lines of the municipal electric lighting plant. It is expected that most of the work will be done this summer. J. H. West is manager.

KEYPORT, N. J.—The Middlesex & Monmouth Electric Light & Power Company contemplates installing a 1,000-kw Westinghouse steam turbine in its plant. F. D. Low is manager.

RED BANK, N. J.—The Shore Electric Company is contemplating the installation of two 300-kw turbines, transformers, regulators, etc., in its plant. Gen. F. F. Gardiner is manager.

SUMMIT, N. J.—At a meeting of the Common Council held Aug. 8 an ordinance was passed granting the Morris County Traction Company a 30-year franchise to construct an electric railway in Summit.

MORRISTOWN, N. J.—The Public Service Corporation of New Jersey contemplates increasing the capacity of its plant in Morristown. A boiler of 250 hp, a 350-hp engine and an alternating-current generator of 300-kw capacity will be installed in the plant. A. H. Lynch is superintendent of the plant.

GREENE, N. Y.—The citizens are contemplating the extension of the municipal arc lighting system. T. H. Williams is manager.

HEMPSTEAD, L. I., N. Y.—B. M. Van Dorn, of Hempstead, writes that the proposed electric light plant for Hempstead, will cost about $70,000.

JAMESTOWN, N. Y.—The Jamestown Lighting & Power Company is contemplating increasing the capacity of its engines and dynamos. Albert S. Price is manager.

ELLICOTTVILLE, N. Y.—The plant of the Ellicottville Electric Light Company is nearly completed and is expected to be in operation by Sept. 1. M. Murphy is manager.

HAMBURG, N. Y.—The Ontario Power Company has submitted a proposition to the Village Board for furnishing electricity for a lighting plant. The present contract for village lighting expires next month.

HOOSICK FALLS, N. Y.—The Hoosick Falls Illuminating Company is installing a 500 hp Sterling boiler, and expects to put in a 400-kw generator to take the place of a 200-kw machine. E. E. Larrabee is manager of the company.

CATSKILL, N. Y.—The new electric light station between Tannersville and Hunter was totally destroyed by fire Aug. 17. The plant furnished electricity to Tannersville, Hunter and Haines Falls, and its destruction leaves these towns in darkness.

ONEIDA, N. Y.—The Board of Public Works has awarded the contract to light this city for five years from Jan. 1, 1907, to the Empire State Power Company, of Amsterdam, at $37.50 per year for all night lamps, $25 for 1 o'clock lamps. The contract calls for 2,000-cp lamps.

PENN YAN, N. Y.—The Yates Electric Light & Power Company is now replacing its old 133-cycle plant with the 60-cycle, two-phase system. The company will also install this year two more water wheels of 266 hp capacity each, made by the Platt Iron Works, and two additional General Electric generators with a capacity of 150 kw each. W. Stanley Buren is manager.

FT. SLOCUM, N. Y.—Capt. E. V. Jones, Quartermaster, U. S. A., writes that contracts for constructing lighting system at Ft. Slocum have been awarded as follows: To the Western Electric Company of New York City, for wiring and electric fixtures, for $10,181, and to the W. B. Foster Electric Company, of New York City, for sub-marine transmission and other lines, $9,800.

STAMFORD, N. Y.—The Stamford Electric Light Company has consolidated with the West Branch Light & Power Company. The new company will assume control of the business Oct. 1. The company is now installing a hydro-electric plant of 200-hp capacity at South Kortright. When completed the plant will furnish electricity for lighting South Kortright, Hobart and Stamford. The Stamford plant will be kept intact to be used in case of emergency or low water. John P. Grant is president.

WATERTOWN, N. Y.—The Watertown Electric Light Company has commenced the work of remodeling its plant and installing new machinery. In addition to the present apparatus, four 240-kw, revolving field, three-phase, 60-cycle alternators direct connected to water wheels will be installed; also a 600-kw alternator of the same type direct connected to a 1,000-hp engine. The present street lamps will be replaced by General Electric magnetite lamps. It is expected to have the plant and the street lighting system completed by October 15.

FISHKILL, N. Y.—The Southern Dutchess Gas & Electric Company, of Fishkill and Matteawan, an electric light company operating under lease the plant of the Citizens' Railroad, Light & Power Company, has made application to the State Commission of Gas and Electricity for permission to issue bonds for $90,000 to acquire and improve the property lately owned and operated by the Fishkill & Matteawan Gas Company, a gas plant recently sold under foreclosure of a mortgage given to the Knickerbocker Trust Company to a committee of bondholders.

WADDINGTON, N. Y.—The New York & Ontario Power Company has made application to the State Commission of Gas and Electricity for a certificate of authority to transact business and for consent to issue $2,000,000 of bonds and $2,000,000 in stock. The company proposes to purchase and develop a dam and water power across the St. Lawrence River from the Isle au Rapid Plat to the south side of the St. Lawrence River to furnish electricity for power and light to Waddington and Ogdensburg, about 20 miles distant, and will also furnish power for the tin plate plant at Morrisburg, Ont.

LOCKPORT, N. Y.—The Lockport Gas & Electric Light Company has submitted a proposition to the city, offering to release the city from the present street lighting contract by which it pays $75 per year for each arc lamp and substituting one to be extended three years from Sept. 1, giving the city arc lamps at $50 each per year, which would save the city $18,000 in three years. The company also offered to reduce the price of illuminating gas from $1.40 to $1 for all consumers. In return for the concession the company wants the city to grant it a franchise for a high voltage electric power transmission line through the city.

WELDON, N. C.—The Roanoke Navigation & Water Power Company is installing a 300-kw generator and a 400-hp water wheel in its plant at Weldon. P. H. Gadsden is president and manager.

HICKORY, N. C.—The Thornton Light & Power Company will install in the near future a hydroelectric plant of 5,000 hp on the Catawba River three miles from Hickory. M. E. Thornton is president and manager.

CHARLOTTE, N. C.—The Southern Power Company contemplates extending its transmission lines from Great Falls to Spartansburg, S. C., on to Greenville, a distance of 30 miles, and also to Columbia, forming a triangle with two sides 100 miles in length.

GASTONIA, N. C.—The municipal electric lighting system will soon be operated by a hydro-electric plant. Three 150-kw transformers of 11,000 to 2,300 volt, are now being installed. It is expected to have the plant in operation by Sept. 1. H. Rutter is superintendent.

NEWTON, N. C.—Plans and specifications are now being prepared for a water works system and an electric light plant for the city. As soon as plans are completed the committee will decide whether or not the work will commence this summer or wait until next spring. W. B. Gaither is mayor.

BREVARD, N. C.—The Brevard Light & Power Company is preparing to change its plant from steam to water power, and will commence work on the construction of a hydro-electric plant about October 1. The company has recently been reorganized with a capital stock of $25,000, but officers have not yet been elected. J. W. Chapman is manager.

CHARLOTTE, N. C.—The Spartanburg Electric Power Company will expend about $1,000,000 in the development of power plants on three sites in this section. One of the sites is Nesbit Shoals in Spartanburg County, S. C., and the others are in Cherokee and Cleveland counties, N. C. R. C. Crawford, J. Slack and F. H. Dravo, of Pittsburg, Pa., are interested.

COLUMBUS, OHIO.—The Columbus Railway & Light Company will build a two-story addition to its power house on Spring Street.

GALION, OHIO.—The City Council is considering a proposition to issue $8,500 in bonds for the improvement of the electric light plant.

HICKSVILLE, OHIO.—The Hicksville Electric Light Company expects to install another engine in its plant. C. M. Lott is president and manager.

YOUNGSTOWN, OHIO.—At a meeting of the City Council held recently a committee was authorized to investigate the cost of a municipal electric lighting plant.

YOUNGSTOWN, OHIO.—The United States Telephone Company will spend about $100,000 in improvements in Youngstown this fall, erecting some new main lines and placing a number of its lines underground.

MADISONVILLE, OHIO.—A new series arc machine of 100-light capacity will be installed in the municipal electric lighting plant, and about two miles of line extension will be made. F. S. Pritchard is manager.

LEXINGTON, OHIO.—A new 100-hp producer gas engine is now being installed in the electric plant owned by Boyd H. Smth. The dynamo capacity will be increased and the lines will be extended in the near future.

YOUNGSTOWN, OHIO.—The Youngstown & Southern Railway Company has awarded the contract for the engineering work and electrification of its lines between Youngstown and Columbiana to J. G. White & Company, of New York, N. Y.

FREMONT, OHIO.—The Lake Shore Electric Railway Company is planning to install a 2,000-kw turbine and additional boiler equipment in its Fremont Power station, to supply electricity for the new Sandusky, Fremont & Southern line, which will be built next year.

COSHOCTON, OHIO.—The Coshocton Light & Heating Company is changing its plant from steam to water power, and is in the market for a complete equipment. The company is now constructing a hydro-electric plant of 1,800 hp. W. A. Himebaugh is president and manager.

CINCINNATI, OHIO.—The Board of Public Service has taken steps for the sale of the telephone franchise in the city of Newport. The city authorities claim that the Citizens' Telephone Company has no franchise right in the city, and will offer the sale of the franchise to the highest bidder.

TIFFIN, OHIO.—The project to build a hydro-electric plant on the Sandusky River between Tiffin and Fort Seneca has been abandoned by the syndicate, owing to the opposition of the landowners north of the city, who held the right of way at a figure considered exorbitant by the promoters.

VERSAILLES, OHIO.—The citizens have decided to increase the capacity of the municipal electric lighting plant and to remodel the power house. A 125-kw, direct-current generator and an engine of 175 hp will be installed. The machinery has not yet been purchased and the managers are open to bids for the same. J. F. Herbst is superintendent.

CANTON, OHIO.—The Merchants' Light, Heat & Power Company, which was recently acquired by parties identified with the Stark Electric Railway Company, is making extensions to its underground electric lighting system. Conduits are being laid throughout a wide district heretofore untouched. F. L. Mawrey, general manager of the Stark Electric Railway, Alliance, is in charge of the work.

YOUNGSTOWN, OHIO.—Councilman Solomon S. Davis has submitted to the City Council estimates on the cost of a municipal lighting plant. He estimates that a plant having a capacity of 500 hp of engines, generators and boilers, 500 arc lamps, 5,000 poles, 150 miles of wire and other necessary equipment, would cost $91,000 exclusive of buildings and land. He will endeavor to get before the people a proposition to spend $150,000 in the erection of a municipal plant.

NEWARK, OHIO.—The Licking Light & Power Company is greatly increasing the capacity of its power plant. The additional machinery now being installed will be operated by natural gas. The new equipment consists of two 200-kw, two-phase, 60-cycle, 2,200-volt Westinghouse generators direct connected to two 290-hp, three-cylinder Westinghouse gas engines: A 165-kw Westinghouse generator similar to the above, direct connected to a 210-hp Westinghouse three-cylinder gas engine, and nine panel switchboard will also be installed. R. C. Douglas is engineer of new construction.

DAYTON, OHIO.—The Dayton Citizens' Electric Company has increased its capital stock from $100,000 to $1,500,000. The following board of directors has been elected: Valentine Winters, Adam Schantz, S. W. Davis, E. J. Barney, George Sohngen, S. J. Patterson, of Dayton, Edward Sonngen, Edward Murphy, of Hamilton, and George B. Cox, of Cincinnati. Mr. Winters was elected president and treasurer. Mr. Schantz and Cyrus E. Meade, secretary and general manager. The company will expend $1,000,000 during the present year in the erection of its lighting system in Dayton. The work of installing an extensive underground system is already under way.

PORTLAND, ORE.—The United Railways of Portland has asked for bids for the construction of the city lines included in its interurban projects. It is estimated by the officials of the company that the building of the city lines will cost at least $750,000.

CAMBRIDGE SPRINGS, PA.—The Cambridge Springs Electric Light Company will soon install new arc lamps for the city.

MT. JOY, PA.—Geo. R. Hersey, J. Hector McNeal and others have petitioned for a charter for the Mt. Joy Electric Company.

SCRANTON, PA.—The plant of the Lackawanna Light Company will commence operation about Aug. 15. G. H. Walbridge is manager.

WELLSBORO, PA.—The Wellsboro Electric Company has just completed the rebuilding of its plant. W. S. Culver is superintendent.

HYNDMAN, PA.—The Hyndman Electric Light & Power Company is contemplating the installation of a larger engine in its plant. N. A. Blair is manager.

MAHANOY CITY, PA.—The Mahanoy City Light, Heat & Power Company will soon place a contract for another 300-hp boiler. Wallace Haldeman is manager.

WEST LIBERTY, PA.—The Council has granted a franchise and contract to the Southern Light, Heat & Power Company to supply the borough with 75 lamps at $70 per lamp per year.

NICHOLSON, PA.—The Nicholson Light, Heat & Power Company is contemplating the construction of a 200-hp hydro-electric plant with steam auxiliary plant. M. J. Shields is treasurer and manager.

WEST MIDDLESEX, PA.—An ordinance has been passed by the Council granting a franchise to the Sharon & West Middlesex Street Railway Company to operate a street railway in the Borough of West Middlesex.

SHARON, PA.—Engineers from the Westinghouse Company have been in this city and all over the lines of the electrical company inspecting the lines, with a view to begin the work of improving the system. About $1,000,000 will be spent in the work.

JOHNSONBURG, PA.—The Johnsonburg Electric Light, Heat & Power Company has recently placed an order for a 150-hp gas engine and 100-kw, three-phase, 2,200-volt alternator, and will establish a 24-hour service by September. The whole plant is practically under construction. H. F. Hitner is manager.

FORD CITY, PA.—The new power plant which is being installed by the Pittsburg Plate Glass Company in factory No. 4 is nearing completion and will soon be put in operation. It is the intention of the company to use the present power plant after the new one is in service, to furnish electricity for lighting the entire glass works, while the new plant will be used exclusively for furnishing power for running the machinery. Two 800-kw generators have been placed in the new plant.

PITTSBURG, PA.—The Pittsburg Reduction Company has secured control of the electric power facilities at Massena, N. Y. The company has bought the controlling stock of the St. Lawrence County Electric & Water Company, the St. Lawrence Water Company and the Massena Electric Light & Power Company. The company recently purchased the St. Lawrence River Power Company, which owns the canal between the St. Lawrence and Grasse Rivers, now developing 35,000 hp, with an ultimate capacity of 150,000 hp. R. B. Mellen is president.

GREENVILLE, S. C.—The Greenville Electric Company is now being formed by local men and will soon apply for a charter. The capital stock will be $25,000.

FORK SHOALS, S. C.—The Fork Shoals Cotton Mills have added $50,000 capital to the capital stock for the purpose of installing electrical and mill machinery.

DILLON, S. C.—The citizens are considering the question of changing the municipal electric lighting system from direct to alternating current. J. T. Woodward is manager.

ANDERSON, S. C.—The Piedmont Electric Company has increased its capital from $27,000 to $40,000, and will make extensions. Its Greenville branch will be enlarged principally. The company is now operating in all the larger towns of upper Carolina and in Georgia.

CHARLESTON, S. C.—The Southern Electric Construction Company has the contract for building the Summerville Electric Railway, work on which is said will soon be started. The president of the electric line is Ogden Edwards, of Troy, Ohio, who will locate in Summerville.

COLUMBIA, S. C.—The new steam auxiliary power plant of the Columbia Street Railway, Light & Power Company is nearly completed, and will soon be ready for the machinery to be installed. Two Westinghouse-Parsons steam turbines of 1,500 kw each, and six Sterling water tube boilers having a total capacity of 3,000 hp will be installed. The plant will be operated only at low water periods and in flood times, or in case of emergency.

COAL CREEK, TENN.—W. M. Banks and D. C. Taylor have decided to construct an electric light plant.

UNION CITY, TENN.—A new 90-hp engine is being installed in the municipal electric light and water works plant. A. Wade is manager.

MIDLOTHAN, TEX.—The Midlothan Milling Company has sold its electrical equipment to the Midlothan Ice, Light & Water Company.

SHERMAN, TEX.—The central office of the Grayson County Telephone Company was recently destroyed by fire entailing a loss of $10,000.

BARTLETT, TEX.—The Bartlett Gin & Electric Company contemplates doubling the capacity of its plant. W. R. Decker is treasurer and manager.

EAGLE LAKE, TEX.—The Eagle Lake Manufacturing Company will install another 45-kw, direct-current generator and engine. The engine has already been purchased. E. S. Scott is secretary and manager.

COLLEGE STATION, TEX.—Extensive improvements are contemplated for the Agricultural & Mechanical College electric and water plant, an electrically operated pump for water plant, cooling tower for ice plant, water and electric meters and storage battery for day load will be installed. The system will be rewired inside and out. N. H. Brown is manager.

HOUSTON, TEX.—The Houston Electric Light & Power Company has made an agreement with the residents of Hyde Park, a suburb of Houston, to supply them with electricity for lighting and power at the same rates allowed the business portion of the city. Work will commence at once on the extension of the lines which will require about 50 miles of wire. W. H. Chapman is manager.

SALT LAKE CITY, UTAH.—Frank J. Wescott has purchased a site on Commercial Street, where he will install a large lighting and power plant.

FOUNTAIN GREEN, UTAH.—The establishment of a local telephone service is contemplated by the Big Spring Electric Company. N. P. Aagard is manager.

SALT LAKE CITY, UTAH.—Arrangements have been made by the Salt Lake Public Service Company for the construction of a heating and power plant in this city.

NATIONAL SOLDIERS' HOME, VA.—B. A. Beeson, treasurer, writes that Crook-Horner Company, of Baltimore, Md., has secured the contract for furnishing and installing three 150-hp steam boilers for $7,500.

BLACKSBURG, VA.—The Blacksburg Power & Supply Company will soon erect an electric light plant and is in the market for a gas producer plant, machinery for an ice plant and electrical machinery. D. H. Heister is manager.

MANASSAS, VA.—It is reported that bonds to the amount of $50,000 are to be issued for an electric light plant, water works and macadam streets, and it is reported that bids for this work will be received until September 16. O. E. Newman is chairman.

ALEXANDRIA, VA.—E. E. Mandeville, of Philadelphia, Pa., secretary and treasurer of the Alexandria Electric Company, writes that bids are wanted at once on the construction of the proposed electric light plant, which will cost about $100,000. W. L. Mathews is president of the company.

WINCHESTER, VA.—The Winchester & Washington City Railway Company has filed a deed of trust, conveying all its property, which consists of the power plant at Millville, a sub-station at Berryville, and a reserve plant at Winchester, to R. Gray Williams and A. Moore, Jr., to secure a issue of $125,000 bonds.

TACOMA, WASH.—The Syndicate Heat & Power Company contemplates increasing the dynamo capacity of its plant during the next year. Calvin Philips is manager.

HOQUIAM, WASH.—At a recent meeting of the Council an ordinance was passed granting a franchise to E. C. Finch and associates to operate a telephone system in this city for a period of 25 years.

TEKOA, WASH.—The Mahoney Light & Power Company has recently installed new transformers, five motors and a pump in its plant. The company does the pumping for the city water plant. F. J. Mahoney is secretary and manager.

BELLINGHAM, WASH.—The Whatcom County Railway & Light Company is changing its plant from steam to water power. The company is now erecting a hydro-electric plant and building a transmission line having a potential of 38,000 volts, 41 miles from Bellingham. The company expects to have an initial development of 3,000 hp completed by Oct. 1. L. H. Bean is local manager.

CHARLESTON, W. VA.—The Kanawaha Light & Water Company has decided to construct a plant at this place.

GRAFTON, W. VA.—The question of installing a new boiler of 125 hp capacity in the municipal electric lighting plant is now being considered. J. Jones is superintendent.

SUPERIOR, WIS.—Estimates are now being received for the construction of an electric lighting plant for the city.

CHIPPEWA FALLS, WIS.—The Chippewa Valley Electric Railway Company is contemplating the extension of its lines to Menominee.

IRON RIVER, WIS.—The Iron River Water, Light & Power Company has commenced work on the construction of a new power station.

ASHLAND, WIS.—The Wisconsin Telephone Company will make extensive improvements to its system in this city at a cost of about $25,000.

MILWAUKEE, WIS.—The Elomkun Electric Company has secured from the County Trustees for the Almshouse and County Hospital, the contract for the central heating and lighting plant, for $18,040.

EAGLE RIVER, WIS.—Bids will be received until August 25 by the Town Board, of which Frank Beardsley is clerk, for constructing a municipal electric power plant dam across the Wisconsin River, four miles of transmission line from the dam to Eagle River, and a water works pumping equipment, all complete.

KENOSHA, WIS.—The Milwaukee Engineering Company, of Milwaukee, has completed plans and estimates for the proposed municipal lighting plant, to consist of power house, a 130-kw alternator, an exciter, three 100-hp water tube boilers, with stokers, 300 nominal 2,000-cp arc lamps, 300 lamp hangers with pulleys, and 2,200 iron braces. The cost of the proposed plant will be about $30,000.

LA CROSSE, WIS.—It has been announced that the stock issue of the La Crosse Water Company for $3,000,000 has been sold to the State Bank of Chicago and the Trowbridge & Niver Company, of Chicago, Ill. The work includes the construction of a dam at Mormon Ripples, near Black River Falls, and the construction of an electric railway between La Crosse and that city. The road will ultimately be extended to St. Paul.

ST. MARY'S, ONT.—Capitalists of this town and Embro are promoting a scheme to construct an electric railway to connect the two towns.

PARRY SOUND, ONT.—The city is now installing a new electric light plant and will discard the present plant as soon as it is completed. G. Groves is superintendent.

BOBCAYGEON, ONT.—Work on the municipal electric light plant is progressing. The plant is expected to be completed and in operation by Oct. 1. W. C. Moore is manager.

STRATHROY, ONT.—The Commissioners of the municipal electric light and water works plant are contemplating the installation of a new engine and a 100-kw, two-phase dynamo in the electric light plant. A. MacLachlan is manager.

FORT WILLIAM, ONT.—The City Council has instructed the town solicitor to prepare a by-law to be submitted to the people to build an electric railway through the town, the same to be operated by the city or leased to a company.

WELLAND, ONT.—The Cleveland Electric Light & Power Company will soon discard its local plant and install a sub-station, taking power from the Hamilton Cataract & Power Company at De Cew Falls. The company will also furnish electricity for commercial purposes. F. W. Houston is superintendent.

New Industrial Companies.

THE TELEGRAPHONE IMPROVEMENT & SECURITIES COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $2,000. The incorporators are F. F. Phillips, W. F. Kilcullen, A. R. O'Neil, of New York, N. Y.

THE ECONOMY ELECTRIC COMPANY, of Warren, Ohio, has let the contract for the erection of a new factory. The building will be 43x140 ft. and three stories high, and will adjoin the plant of the Warren Electric & Specialty Company with which the company is closely affiliated.

THE TUBAPHONE MANUFACTURING COMPANY, of Indianapolis, Ind., has been incorporated for the purpose of establishing a factory for the manufacture of motor vehicle accessories. The capital stock is $10,000. The directors are Wm. J. Miller, Jno. W. Comstock and Jno. W. Oswold.

THE DALLAS LIGHT & EQUIPMENT COMPANY, of Dallas, Tex., has filed articles of incorporation with a capital stock of $100,000. The incorporators are J. B. Nabors, E. C. Bird, John A. Barnard and others. The purpose of the company is to manufacture lamp shades, equipments and similar devices.

THE ELMER H. CATLIN COMPANY, of Washington, D. C., has filed a certificate of incorporation with the recorder of deeds with a capital stock of $30,000. The incorporators are: O. R. Evans and Elmer L. Evans. The purpose of the company is to manufacture and sell all kinds of gas and electric lighting fixtures.

THE GARL ELECTRIC COMPANY, of Akron, Ohio, has been incorporated by App. N. Garl, Charles H. Isobel, R. E. Innskeep and W. F. Laubach, with a capital stock of $50,000. The company succeeds another company of the same name and it is preparing to move into a larger factory for the manufacture of Garl intercommunicating telephone outfits and signaling devices for steam and electric roads.

THE PITTSBURG ELECTRIC SIGN COMPANY, with headquarters at 220 Collins Ave., Pittsburg, Pa., has secured a charter at Wilmington, Del., with a capital stock of $10,000, for the purpose of manufacturing electric signs, heating appliances and irons. The new company will make a specialty of arranging special lighting effects for socials, weddings, etc. The officers and incorporators are: F. M. Kattenstroth, president; Robert F. Miler, secretary; C. H. Brown, treasurer and E. E. Parson, general manager.

New Incorporations.

FORREST CITY, ARK.—The Forrest City & Cutoff Telephone Company has been organized in this city by J. J. Barron, president; Daniel Wylds, Sr., vice-president, and R. D. Hatcher, secretary and treasurer.

ARGENTA, ARK.—Articles of incorporation have been filed with the Secretary of State by the Argenta Railway Company, with a capital stock of $400,000. The incorporators and officers are J. M. Griffin, president; John G. Vogel and James P. Faucette.

VENTURA, CAL.—The Ventura County Power Company has been incorporated, with a capital stock of $2,500,000, by C. H. McKevett, of Santa Paula; J. A. Driffill, of Oxnard, and J. H. Adams, T. W. Phillipps, J. S. Torrance, J. R. Martin and W. R. Stats, of Los Angeles and Pasadena.

HARTFORD, CONN.—The Evansville Light Company has been incorporated in this city. Capital, $3,000,000. The incorporators are H. Clay Dingee and G. Richard Nichols, of Philadelphia, Pa., and Chas. E. Perkins, of Hartford.

DANVILLE, ILL.—Articles of incorporation have been filed for the Danville & Eastern Railway Company, with a capital stock of $5,000.

CENTER CITY, ILL.—The Chicago Mutual Telephone Company has filed articles of incorporation with a capital stock of $50,000. The incorporators are A. B. Slattengren and others.

DUNLAP, ILL.—Articles of incorporation have been filed with the Secretary of State, with a capital stock of $10,000, for the Dunlap & Alta Telephone Company, by Walter Alten, W. D. Thresie and Oscar Alten.

SPRINGFIELD, ILL.—Articles of incorporation have been filed for the East St. Louis, Granite City & Alton Suburban Railway Company, with the Secretary of State. The purpose of the company is to construct a line from East St. Louis to Alton and Edwardsville. The principal office will be at St. Louis; capital stock is $2,500. The incorporators are L. C. Haynes, C. C. Pierce, T. W. Gregory, F. H. Thomas, of East St. Louis, and F. E. Allen, of St. Louis.

FT. WAYNE, IND.—The DeKalb Fuel, Light & Power Company has been incorporated with a capital stock of $100,000. The incorporators are John Ross McCulloch, O. N. Guildlin and C. H. Price.

MICHIGAN CITY, IND.—Articles of incorporation have been filed with the Secretary if State for the Way Railway Company, with a capital stock of $50,000. G. Emile Kaltenbach is president and Homer Potwin secretary.

ROSEDALE, IND.—The Williams Telephone Company, of Parke County, has filed articles of incorporation with the Secretary of State. James A. Taylor, Jas. H. Adams, G. H. Salmon and George L. Laney are directors.

OTTERBEIN, IND.—The Lafayette & Hoopeston Interurban Railway Company has filed articles of incorporation with a capital stock of $10,000. The directors are: Isaac E. Switzer, William Walsh, Elmer A. Hawkins, Lawrence Burnes and John H. Bankson.

EVANSVILLE, IND.—The Farmers' Heat & Light Company, of this city, has filed articles of incorporation with the Secretary of State. The capital stock is $10,000 and the object of the corporation is to construct gas, heating and lighting plants. The directors are: Hiram A. Gooch, Smith Wiltshire and William Wiltshire.

ROCHESTER, IND.—The Merchants Mutual Telephone Company, with principal offices in this city, has filed articles of incorporation with the Secretary of State. The company proposes to construct and operate telephone lines and exchanges in Fulton and adjoining counties. Alexander Ruh is president, Isaac H. Good, vice-president and J. R. Townsend, secretary.

INDIANAPOLIS, IND.—A new electric railway is being promoted by the citizens of this city to connect Lafayette, Crawfordsville, Greencastle and Bloomington. The company will file articles of incorporation under the name of the Chicago & Western Indiana Traction Company. The officers are Edward H. Barrows, president; D. W. Bolan, vice-president; J. S. McCullough, secretary and treasurer.

BOONE, IA.—The Boone, Webster City & Interurban Railway Company has filed articles of incorporation with the Secretary of State. It has a capital stock of $10,000. The officers are: E. E. Hughes, president; J. C. Regan, vice-president; John S. Crooks, secretary, and J. H. Herman, treasurer.

CASTLETON, N. Y.—Articles of incorporation have been filed for the Upper Hudson Telephone Company, with a capital stock of $10,000. The directors are Martin W. Springstead, of Castleton, and Wakely Best and Albert A. Baker, of Coxsackie.

SEATTLE, WASH.—Articles of incorporation have been filed for the Earlington Electric Company with a capital of $100,000, by J. R. Douglass and others.

WHITE SALMON, WASH.—The White Salmon Water, Light & Power Company, of White Salmon, has been incorporated with a capital of $75,000 by J. C. McInnes and A. H. Jewett.

GRANGER, WASH.—The Farmers' Mutual Telephone Compauy has been organized at Granger, Wash., with a capital of $50,000, and it is announced that connections will be made with the Spokane Home Tele phone Company's lines.

NORTH YAKIMA, WASH.—Articles of incorporation have been filed for the Yakima Intervalley Traction Company, with a capital stock of $500,000. The company proposes to construct, acquire and operate railroads. The trustees are W. A. Bell, H. B. Scudder, I. H. Dills and W. B. Robertson.

SPOKANE, WASH.—Articles of incorporation have been filed with the Secretary of State for the Columbia River Power Company by Jay P. Graves, Charles H. Wolf and William G. Graves. The company proposes to develop the water power at Kettle Falls, Wash., recently acquired by Mr. Graves and associates. The company has a capital stock of $150,000.

SPOKANE, WASH.—The West Coast Traction Company, with a capitalization of $150,000, has filed articles of incorporation at the office of the County Auditor. The incorporators are: C. H. Weeks, of Spokane; B. J. Weeks, of Tacoma; D. D. Leverson, of London; Cyrus Bradley, of Spokane; J. W. Reynolds, of Chehalis; F. B. Hubbard, of Centralia, and W. W. Cannon, of Centralia.

Legal.

TELEPHONE SERVICE REFUSED.—Users of telephone toll lines will be interested in a suit just filed in the district court of Franklin County, Iowa, in which the defendant is the Iowa Telephone Company, and B. H. Mallory, a well-known attorney of Hampton, is the plaintiff. Action is brought for $4,000 damages on the ground that the telephone company refused to let Mallory use the toll lines until a disputed bill was settled. It is stated that the company claimed three dollars of Mallory and the latter disputed the legality of the claim, thus leaving the matter unsettled. Mallory called up an out-of-town party and was advised that the party was ready to talk to Mallory, but as Mallory went to step in the booth he was presented with the disputed bill and told that he could not talk unless the claim was paid. Mallory asked for and was granted an injunction restraining the Iowa Telephone Company from denying him the use of the toll lines. The injunction case as well as the damage suit will be argued at the September term of court.

RIGHTS OF MINORITY STOCKHOLDERS.—Judge Sanborn, handing down a decision of the circuit court of appeals in Missouri in the case of Jones versus the Missouri-Edison Electric Co., made the following statements concerning the duties of majority interests in corporations. "A combination of the holders of a majority of the stock of a corporation to elect directors, to dictate their acts and the acts of the corporation for the purpose of carrying out a predetermined plan, places the holders of such stock in the shoes of the corporation, and constitutes them actual, if not technical, trustees for the holders of the minority of the stock. Such a majority owe to the minority the duty to exercise good faith, care and diligence, to make the property of the corporation produce the largest possible amount, to protect the interests of the holders of the minority, and to secure and deliver to them their just proportion of the income and of the proceeds of the property. Any * * * disposition by them of the corporation or of its property to deprive the minority stockholders of their just share of it, or to get gain for themselves at the expense of the holders of the minority, becomes a breach of duty and of trust which invokes plenary relief from a court of chancery."

Obituary.

MR. H. D. CURTISS.—The death is announced of Mr. Horace D. Curtiss, of Woodbury, Conn., at the age of 65. He was the son of D. Curtiss, and for a great many years was president of the Daniel Curtiss' Sons Woolen Mills. He was a member at one time of the House of Representatives, the State Senate, and the Constitutional Convention of 1902. He was also president of the Woodbury Electric Light Company and the Woodbury Water Company. He had been in poor health for ten years past.

CAPT. E. B. C. HAMBLEY, manager of the Whitney Company, whose immense electrical plant is being developed near Salisbury, N. C., died on Aug. 13 after a long illness, caused by fever. Capt. Hambley came from England to investigate mining properties, and soon went South where for years he has been of immense aid to the country in its new-born plans of development. He was a man of large grasp of mind and could size up a speculative proposition in the way of new developments better than any man of his class. He made many friends in the southern part of the country and his name was connected with one of the biggest electrical developments of the time in the South.

MR. JAMES DREDGE.—We regret to learn by cable the death of Mr. James Dredge last week, in London. As the editor of *Engineering* he had an international reputation, confirmed by his work in connection with various great expositions. Mr. Dredge served his apprenticeship in the works of Sir John Fowler at the same time as Sir B. Baker and Mr. Latrobe. His tastes led him toward journalism and the building up of *Engineering* evidenced his great capacity in that direction. He was also the author of many books, the first to attract attention being that on "Modern French Artillery." He took a deep interest in expositions and was a Royal Commissioner at Philadelphia, 1876; Chicago, 1893, and many others. He was a member of the Legion of Honor and was invested by Queen Victoria with the order of Commander of St. Michael and St. George.

Personal.

MR. G. WILBUR HUBLEY, the superintendent and chief electrical engineer of the Louisville, Ky., Lighting Company, has sustained a severe loss in the death of his wife at the Norton Infirmary, that city. The interment took place at Cincinnati, on August 19.

MR. E. J. KOPPITZ, engineer for Westinghouse, Church, Kerr & Company, leaves this week for Rochester to superintend the installation of the 11,000-volt single-phase railway plant being installed for the Erie Railway between Rochester and Mt. Morris by Westinghouse, Church, Kerr & Co.

DR. A. E. KENNELLY.—A popular work on "Wireless Telegraphy," by Prof. A. E. Kennelly of Harvard University, will be issued by Moffat, Yard & Co. in the Fall. The subject is brought down to date. It is described clearly and its history is given. The volume will be profusely illustrated with diagrams and plans.

MR. VON BAUR, engineer of the Cooper Hewitt Electric Company, gave a lecture on Aug. 17 before the members of the sales department of the Narragansett Electric Light Company, and others, Providence, R. I., on mercury vapor lamps and rectifiers. The affair was managed by Mr. E. R. Davenport, the sales agent.

MR. CECIL B. SMITH, of Toronto, Can., has been retained by the power commission of Winnipeg, Manitoba, at a salary of $10,000 a year for not less than two and a half years, to act as engineering superintendent of construction for the city power plant on the Winnipeg River, and the transmission and distribution of the current.

MR. RALPH W. POPE, secretary of the American Institute of Electrical Engineers, arrived at Montreal, Aug. 11, on the turbine steamer *Victoria*, of the Allan line. He has resumed his duties at 95 Liberty Street, New York, after an absence of two months in England and Scotland in connection with the visit of the Institute to Great Britain on the invitation of the Institution of Electrical Engineers.

MR. W. W. S. BUTLER, of Grand Rapids, Mich., has been appointed General Manager of the Newport News and Old Point (Va.) Railway and Electric Company, and its constituent companies, the Citizens Railway, Light and Power Company, Norfolk and Atlantic Terminal Company, Hampton Roads Traction Company and Newport News Gas Company. He was general superintendent of the Grand Rapids street railways.

MR. W. MARCONI.—Cable advices from London announce that Marconi, the inventor of the wireless telegraph, has joined the experimental staff of the Columbia Phonograph Company. Edward D. Easton, president of that company, has just returned from London, where he was in negotiation with Mr. Marconi with a view to securing his services in the further development of the science of recording and reproducing sounds. The cable message confirms Marconi's acceptance.

Trade Publications.

RAILWAY MOTOR.—A complete list of parts of the GE-80-A direct-current railway motor is given in bulletin No. 4450 of the General Electric Company, Schenectady, N. Y.

MARINE SUPPLIES.—Catalogue No. 7597 of the General Electric Company, Schenectady, N. Y., illustrates and describes water tight electric lighting supplies for marine work.

SHELL-TYPE TRANSFORMERS.—An outline of the requirements in the construction of a transformer for satisfacory operation is contained in bulletin No. 1081 recently issued by the Fort Wayne Electric Works, Fort Wayne, Ind.

SHEET METAL WORKING MACHINERY.—A convenient vest-pocket note book containing much information of value to machinists is to be found in an illustrated catalogue of standard machines issued by the E. W. Bliss Company, Brooklyn, N. Y.

ARC LAMPS.—The Stanley-G.I. Electric Mfg. Company, Pittsfield, Miss., has issued circular No. 775, describing inner globes for all kinds of arc lamps. Bulletin No. 607 of the same company deals with hanger boards for arc lamps of the constant potential type.

ALTERNATING-CURRENT MOTOR STARTERS.—The General Electric Company, Schenectady, N. Y., has issued bulletin No. 4446, giving an illustrated description of compensators for starting alternating-current motors by reducing the potential applied at the terminals.

GAS GENERATORS.—The Cone Gas Machine Company, Detroit, Mich., has issued a pamphlet describing and explaining the Cone gas machine and the process applied by it. Much interesting information is given concerning the comparative costs of obtaining energy by means of steam-driven electric generators and directly by the use of gas generators and engines.

CONTROLLERS.—Bulletin No. 4443 of the General Electric Company, Schenectady, N. Y., contains a complete outline of apparatus required for the control of series motors when operated interchangeably on direct-current and alternating-current circuits. The system described is similar to the Sprague-General Electric type M, multiple-unit control for direct-current operation.

FLINN STEAM TRAP.—Bulletin No. 137 has just been issued by the B. F. Sturtevant Co., of Boston, Mass., as one of its engineering series. This publication is devoted to a description of the Flinn steam trap, which is now manufactured by the Sturtevant company. This trap, which is of the differential type, with water column and diaphragm, is capable of handling water at any temperature; in fact, the temperature has nothing to do with its action. Without readjustment it works equally well at any pressure below its maximum. It is not affected by vibration or oscillation, and is therefore especially adapted to marine practice. It has but three moving parts, and its application is general in connection with all classes of steam installation.

THROUGH FRISCO'S FURNACE is the title of a brochure issued by the Joseph Dixon Crucible Co., of Jersey City, N. J. The seven half-tone illustrations are unquestionably among the best views that have been shown of modern steel-frame constructed buildings at San Francisco, that withstood the earthquakes and fire of April 18, 1906. The pamphlet tells in an interesting manner of the originality of the American architect and engineer, and of the soundness of their steel constructed buildings, under the crucial test of earthquakes, dynamiting and fire. The purpose of the publication is to show how well Dixon's silica-graphite paint preserves the maximum strength of steel work of high buildings so that severe strains can be successfully resisted.

KEYSTONE GREASE.—The Keystone Lubricating Company, of Philadelphia, has issued a folder, the title of which is "Comparative Weight, Volume and Price of Lubricants." In it an interesting comparison is made between oil and grease on the basis of weight and volume. A gallon of the average lubricating oil weighs 8.051 pounds, while Keystone grease is guaranteed to be equal to 4 to 6 gallons of any oil for lubricating purposes. Therefore, the guarantee may be made to read that one pound of Keystone grease would equal 40.255 to 48.306 pounds of any lubricating oil. A gallon of Keystone grease weighs 8.3 pounds, so that on the same basis one pound of Keystone grease is equal to 40 to 48 pounds of any oil, and a gallon of Keystone grease is equal to 333 to 400 gallons of any oil.

MOTOR STARTERS.—The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has issued a series of bulletins for insertion in its loose-leaf catalogue. Bulletin No. 10 deals with a multiple-switch starter with automatic release for a 5-hp, 220-volt motor. Bulletin No. 10 illustrates and describes a motor starting rheostat with automatic release, and enclosed unit type moisture-proof resistances. Bulletin No. 17 is devoted to double-lever motor-starting rheostats with automatic release and interlocked overload circuit breaker. Field rheostats are discussed in bulletin No. 32. Radial-arm reversible controllers for cranes and hoists are treated at great length in bulletin No. 59. Bulletin No. 70 gives an outline of the features embodied in the construction of self-starters for motors, while bulletin No. 92 furnishes a descriptive price list of "Simplicity" dimmers for two-wire and for three-wire circuits.

RAILWAY AND LIGHTING SUPPLIES.—The supply department of the General Electric Company has issued the following flyers for insertion in its supply catalogue: No. 21, controlling rheostats with no-voltage and overload release for use with shunt or compound wound motors; No. 2178, key and keyless receptacles; No. 2179, all-porcelain wireless clusters; No. 2180, porcelain sockets; No. 2181, receptacles for outdoor wiring; No. 2182, copper-ribbon fuse boxes; No. 2183, hood switches for railway service; No. 2184, fuse holders for 2,300-volt and 6,600-volt circuits; No. 2185, moulding rosettes; No. 2188, fuse boxes for installation in manholes; No. 2189, Edison reflector lamps; No. 2190, cast grid field rheostats; No. 2192, motor starting rheostats with no-voltage release for shunt and compound motors. The following price lists have also been issued: No. 5145, type H oil transformers; No. 5146, type HB oil transformers; No. 5147, electric heating devices; No. 5152, Gem incandescent lighting units.

News of the Trade.

GOULD STORAGE BATTERY.—After Sept. 1 the San Francisco representatives of the Gould Storage Battery Company will open permanent offices in the newly restored Monadnock Building. Previous to the earthquake and fire the Gould Company had offices in the Crossley Building, which was destroyed, while for the last four months temporary offices at 1701 Geary Street have been occupied.

ELECTRIC CABLE COMPANY.—The new Voltax liquid compound is being extensively used as a waterproof paint. Casper Ranger, of Springfield, Mass., is using a large quantity of this material for painting stone work in order to prevent moisture from sweating through. This compound has been similarly used as a paint for steam and cold water pipes, as it has proven to be a preventive of moisture. The manufacturers of this material, the Electric Cable Company, of 17 Battery Place, New York, states that the Voltax liquid compound is being extensively used as a paint for furnace doors and stacks on which it has been found to withstand an exceedingly high temperature.

ALLIS-CHALMERS WATER POWER PLANTS.—The general application of electricity to power work and the facility with which electrical energy may be transmitted over long distances, has furnished the necessary incentive towards the development of the hydraulic turbine; and value of the so-called "waste" water powers of the country, which, up to within the past few years, it has been considered impracticable to utilize, is now meeting with proper recognition. Allis-Chalmers electrical machinery has been, for some years, installed in many of the hydro-electric plants of North America before the name Allis-Chalmers Company came to be associated with hydraulic turbines and the building of hydraulic machinery. Since its entrance into the hydraulic field, however, the record for Allis-Chalmers water turbines has been nothing less than remarkable, while the aggregate horse-power of the hydro-electric plants of North America in which Allis-Chalmers apparatus is installed, has reached nearly 900,000. This aggregate is partly composed of installations or orders for turbines alone, amounting to over 200,000 hp.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 14, 1906.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N.Y.]

828,315. ELECTRICAL SYSTEM OF DISTRIBUTION; Albert S. Hubbard, Greenwich, Connecticut. App. filed April 10, 1905. A special rectifying device is provided, which receives an alternating current that varies in accordance with the variations of load on the alternating-current generator. The direct current from this rectifying device is caused to energize or partly energize the field of a generator to govern the direction and intensity of the current from such generator. The current from the latter generator actuates a motor which operates in either direction to add to or remove cells from the battery circuit.

828,319. GALVANIC CELL; Baroykl Jonas, Toledo, O. App. filed Apr. 2, 1904.

828,322. ELECTRIC RAILWAY; Charles J. Kintner, New York, N. Y. App. filed Dec. 5, 1903. Renewed Jan. 11, 1906. The system comprises a current feeder and a power house generator connected thereto, a series of sectional conductors or third rails, normally upon branch feeders and switches for closing the circuit between the current feeder and the sectional conductors, switch controlling electro-magnets included in circuit for local electrical generators beside the track and track-circuit-closing devices controlled by the wheels of a car or train on the track, the generators being wholly out of control of or disconnected from the power house generator when in operation.

828,335. DRY BATTERY CELL; Angelica E. Post, Boston, Mass. App. filed May 17, 1905.

828,356. FIRE-ALARM; Alfred Edward Watts, Wattsburg, Can. App. filed July 13, 1905. Details of an apparatus by means of which when a change of temperature occurs in an apartment, such change may be noted at a given point removed from the apartment and by which an alarm may be given showing the location of the apartment in which the change of temperature occurs.

828,371. ELECTRICITY-METER; Adrian Baumann, Zurich, Switzerland. App. filed Oct. 27, 1903. An electric meter of ordinary construction is connected to a counter by change gearing, for the purpose of enabling electricity to be delivered according to the time of day, at different prices.

828,373. ELECTRICAL SWITCH; Harry A. Beynon, Chicago, Ill. App. filed July 12, 1905. The switch is a floor switch in the form of a mat upon which the operator stands when in position to operate his machine and by means of which the current is supplied continuously as long as pressure is applied on the mat.

828,386. ELECTRIC SIGNALING DEVICE; Henry M. Mascom, Brooklyn, N. Y. App. filed Sept. 21, 1904.

828,388. CONTROLLER; Abe L. Cushman, Concord, N. H. App. filed May 3, 1905. An electro-mechanical apparatus is provided in which a single operating handle operates both the armature control mechanism and field control mechanism, first to place the armature control mechanism in cut-out or short circuit position, where it is automatically locked, and then to operate the field control mechanism independently.

828,419. REGISTER SIGNAL FOR MEASURED-SERVICE TELEPHONE-EXCHANGE SYSTEMS; Frank R. McBerty, Evanston, Ill. App. filed Oct. 7, 1905.

828,420. FIRE-ALARM SYSTEM; Judson McFell, Chicago, Ill. App. filed Aug. 7, 1905. Means are provided for positively opening the circuit of a test-relay magnet upon the actuation of the boxes in the main circuit with said test-relay magnet.

828,446. ELECTRIC SIGNALING APPARATUS; George W. Watkins and Walter C. Bethel, Seattle, Wash. App. filed Jan. 22, 1906. The signal apparatus is particularly adapted for electric railway work and consists of a line circuit, a plurality of normally open signal circuits having stationary circuit terminals formed of resilient metallic strips arranged in close proximity to the roadway, and circuit terminals adjustably mounted on the rolling stock relatively to said stationary terminals and electrically connected with said line circuit.

828,489. TROLLEY POLE CONTROLLER; Milner Lidster and Joseph Hoellig, Los Angeles, Cal. App. filed Dec. 4, 1905. Automatic means

are provided for shifting the power that holds the trolley wheel in contact with the feed wire to bring the pole below the feed wire when the trolley wheel accidently leaves the wire.

828,518. SIGNALING SYSTEM FOR ELECTRIC RAILWAYS; Charles E. Schribner, Jericho, Vt. App. filed Dec. 1, 1905. The invention resides in means for testing the selective operation of a plurality of signals and consists of a selector frame having a series of signal-setting positions concentrically arranged thereon, a series of concentrically arranged signal-testing positions following in inverse order said setting positions, and a rotatable arm, the partial movement of which will give in succession the positions for setting a signal and a subsequent continued movement will give in inverse order the positions for testing the same.

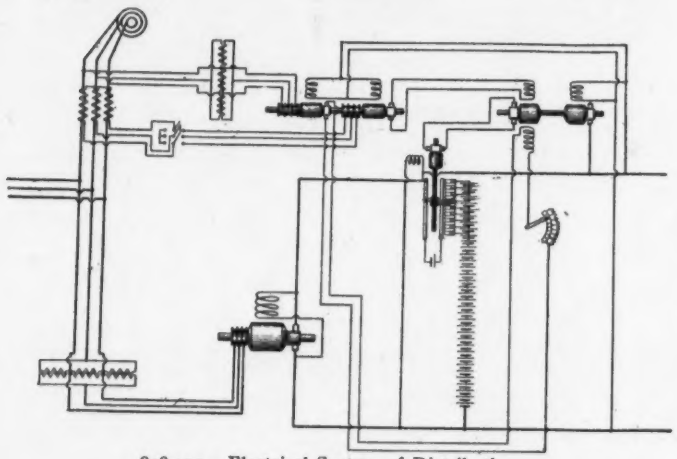
828,544. ELECTRODE FOR ARC LIGHTS; Frederic J. Gerard, London, England. App. filed June 9, 1903.

828,570. ELECTRICALLY OPERATED INDICATOR; Michael C. Regan, U. S. Army. App. filed Jan. 12, 1906. The device is intended for registering the movements of fluid or other bodies at a point distant from the moving body being registered, and comprises means operated by the moving body and forming a contact for making and breaking an electric circuit controlling an electro-mechanical registering apparatus.

828,582. ADAPTER; Alfred Swan, New York, N. Y. App. filed Feb. 6, 1905. The adapter is provided with a locking device which when the adapter is inserted into a receptacle prevents its withdrawal therefrom.

828,584. BRUSH; John K. Thomas, Columbus, O. App. filed Nov. 7, 1905. The invention resides in a method of forming the carbon whereby the same is securely held in the carbon holder. A recess is formed diagonally through the brush from the rear face thereof to the top.

828,585. CIRCUIT CLOSER FOR TROLLEY SIGNALS; Horace Thurston, Providence, R. I. App. filed Jan. 2, 1906. The circuit closer is mounted on or near the trolley wire for operating the signals, the same being actuated through a lever hanging in the path of the passing trolley wheel.



828,315.—Electrical System of Distribution.

828,629. OVERHEAD TROLLEY; William H. Schneider, South Bellingham, Mass. App. filed Feb. 10, 1906. Details of construction.

828,637. MOTOR CONTROLLER; Samuel D. Black, Sherwood, Md. App. filed Feb. 5, 1906. The functions of a starting box and speed controller are combined with safety devices, such as overload and underload cut-outs, and with an arrangement permitting the quick reversal of the direction of rotation of the motor without injurious sparking at the motor brushes.

828,647. MAGNETIC CLUTCH; Lucius T. Gibbs, Hempstead, N. Y. App. filed Aug. 2, 1905. The clutch is made up of one or more friction disks arranged transversely about a power driven shaft and connected with a load to be driven, one or more friction disks arranged transversely about the same shaft and connected therewith, the first disk or disks being arranged alternately with the second, a plurality of radial armature levers arranged to swing longitudinally of the shaft and adapted to press the friction disks together, and electro-magnetic means for actuating the armature levers.

828,655. INDICATING AND WARNING ATTACHMENT FOR GRAIN-BINS; David H. Houston, Hunter, N. D. App. filed Sept. 18, 1905. As the grain in the bin is filled in, the closing of an electric circuit effected thereby actuates an electric bell to indicate the fact that the bin is full.

828,678. ELECTRIC TELPHER POSTAL SYSTEM; Roberto T. Pisicelli, Naples, Italy. App. filed Sept. 5, 1902. The collection of the correspondence is effected by means of small vehicles driven by electric motors and running over aerial lines made of insulated metallic wires which act as guides for the vehicles and as conductors of the electric current.

828,683. TELEPHONE-EXCHANGE SYSTEM; Harry O. Rugh, Chicago, Ill. App. filed Nov. 17, 1902.

828,687. AUTOMATIC CIRCUIT CONTROLLING DEVICE; Richard F. Spamer, Chicago, Ill. App. filed Jan. 25, 1905. The circuit controlling device is connected with a pressure system to be actuated upon a predetermined amount of change in the pressure for operating an electrical alarm circuit.

828,691. ELECTRICAL SIGNAL CIRCUIT; Eugene W. Vogel, Chicago, Ill. App. filed July 10, 1901. Means are provided whereby the bell may be silenced or other signal discontinued while a train occupies a track circuit, while insuring the return of the parts automatically to normal positions as soon as the train pulls out of the circuit.

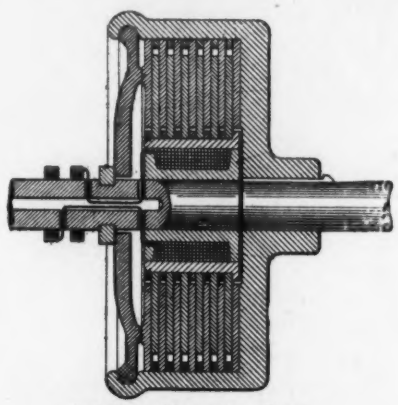
828,693. TELEPHONE SYSTEM; Harry G. Webster, Chicago, Ill. App. filed Dec. 15, 1902.

828,733. CABINET FOR TREATING DISEASES BY LIGHT; Benjamin F. Fuller, El Reno, Oklahoma Ter. App. filed Jan. 17, 1906. The cabinet is polygonal in shape and is formed of flat sections hinged together in sequence, with mirrors carried by said sections, mirrors also carried by the inner face of the top, and arc lamps.

828,739. ELECTRIC SWITCH; Gerald W. Hart, Hartford, Conn. App. filed Nov. 10, 1905. Details of a push-button snap switch.

828,746. ELEVATOR BELL SIGNAL; Jerry King, St. Paul, Minn. App. filed May 23, 1905. The invention resides in a contact device for elevator signals consisting of a pair of current carrying wires, two pairs of contact members, a single means for retaining the contact members in engagement with the wires, and means for limiting the movement of said contact members to prevent them from becoming disengaged from the wires.

828,747. SECTIONAL THIRD-RAIL SYSTEM OF ELECTRIC RAILWAYS; Charles J. Kintner, New York, N. Y. App. filed Jan. 24, 1906. The wheels and axles of a car and the rails are utilized for operating the switches through the agency of electrical currents of such low voltage that there will be little or no leakage between the rails, the circuit at all times being open for the switching apparatus, except when a car or train is passing over any given section or part of the road.



828,647.—Magnetic Clutch.

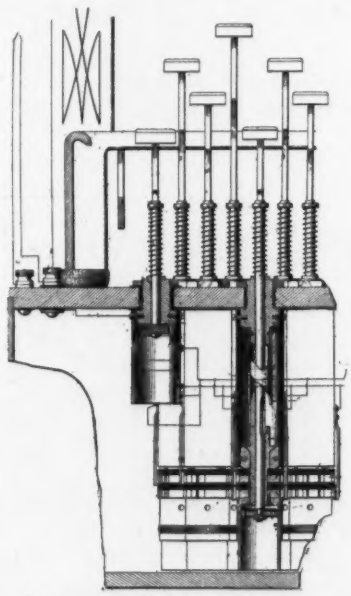
828,775. TELEGRAPH TRANSMITTER; Harlie O. Putt, Millbury, O. App. filed Jan. 16, 1906. The invention resides in a machine for transmitting by telegraph. A series of key stems are located in such position that they will normally rest directly under the keys or key levers of a typewriting machine of the usual construction, which key-stems are ready to be moved into operative position when the keys are depressed in writing. A typewritten copy of the message is produced simultaneously with the transmission thereof by telegraph.

828,788. ELECTRIC CROSSING SIGNAL FOR RAILWAYS; Eugene W. Vogel, Chicago, Ill. App. filed May 30, 1901. The invention comprises electrically operated signals arranged to operate as a railway train approaches a crossing and to be silenced or otherwise discontinued when the first trucks of the train reach the crossing or station, and give no signal whatever as the train, having passed said crossing, recedes therefrom.

828,814. APPARATUS FOR ELECTROPLATING; Frank R. Cunningham, Medford, Mass. App. filed Sept. 11, 1905.

828,834. BURGLAR ALARM; Burton S. Bell, Ree Heights, S. D. App. filed Feb. 6, 1906. Consists of a sectional door holder so constructed that the sections may slide one on the other to a limited extent. The sections carry contacts by which an electric alarm circuit is closed.

828,835. WALL SET; Jules A. Birshfield, Rochester, N. Y. App. filed Feb. 13, 1905.



828,775.—Telegraph Transmitter.

828,848. TELEPHONE SWITCHBOARD; Alexander M. Hanbrich, Chicago, Ill. App. filed Apr. 1, 1904.

828,855. RAILWAY SIGNALING APPARATUS; Otto A. Kindlund, Chicago, Ill. App. filed Dec. 27, 1905. Details of an apparatus to be used in connection with railways for giving alarms when two trains are located on the same track and for permitting communication between said trains.

828,864. RECEIVER FOR WIRELESS TELEGRAPHY; Wilhelm Schloemilch, Berlin, Germany. App. filed June 27, 1905. In the receiver are provided a receiver circuit, two detector circuits electrically connected with the receiver circuit, the detector of the one circuit being less sensitive than the detector of the other circuit, a relay in each detector circuit, a recording apparatus successively operated by both relays, and means operated by the less sensitive detector for breaking or opening the circuit of the more sensitive detector.

828,866. PARTY LINE TELEPHONE-EXCHANGE SYSTEM; Alfred O. Stigberg, Chicago, Ill. App. filed May 6, 1904.